# MOTREC

# E-660

**OPERATOR AND MAINTENANCE MANUAL**
**SPARE PARTS LISTS INCLUDED**

SERIAL NUMBER : 1021002 & UP

Printed in Canada

# One Year Limited Warranty

Effective April 25, 2005, MOTREC, Inc. (MOTREC) hereby warrants to the Original Retail Purchaser (Owner) that any of its vehicles shall be free from any defect in materials for a period of 90 DAYS while in the possession of such Original Retail Purchaser. This warranty IS NOT TRANSFERABLE to any subsequent Buyer.

The warranty period is extended to one year or one thousand (1,000) hours, which ever first occurs, on the electric motor, differential (parts that bathe in oil) and the electronic speed controller. MOTREC makes no warranty or representation with respect to the internal combustion engine, tires and batteries, since their respective manufacturers cover such parts. Accessories (light, gage, horn, etc), electrical contacts (switch, solenoid, contactor, relay), diodes & fuses, belts & pulleys, filters & spark plugs, lubricants, brake linings & shoes, brake drums & discs, seals, seats, trim and other items subject to wear are not included in this warranty; nor is any item that in MOTREC sole opinion, shows evidence of neglect, misuse, abuse, collision or alteration.

This warranty shall not apply to normal maintenance requirements as described in the User Manual, and to damages during shipment. The latter is the carrier's responsibility. No compensation will be allowed for delays.

To initiate warranty coverage on any MOTREC vehicle, the Dealer must complete and return the “Sales/Installation Report” to MOTREC within 30 days after delivery to the Original Retail Purchaser; or within 90 days after the delivery date to the Dealer, which ever occurs first. Failure to follow these procedures will result in considering the warranty coverage effective as of the shipment date from the factory.

The defective vehicle must be returned, at the Owner's expense, to an authorised MOTREC Dealer within 30 days after failure. The Owner will not be charged for parts and labour required for warranty repairs, which must be performed by an authorised MOTREC Dealer only. The vehicle will be returned at the owner’s expense. The Warranty Claim Forms must be completed and returned with the defective part(s) to MOTREC within 30 days after repair was done. No compensation will be allowed for damages caused by vehicle downtime.

It is the responsibility of the owner of the vehicle to make sure that the driver is properly trained and instructed in the safety features and operation of the vehicle, including vehicle stability, as required by OSHA and ANSI-B56. Operators shall read, understand and follow the safety and operating instructions in MOTREC Manual before driving the vehicle. Operators shall not be permitted to drive the vehicle unless a complete and adequate training has been provided. Driving a vehicle constitutes a hazard. The driver is responsible for the control of the vehicle while driving and must always evaluate and care for all peculiar situations that he or she may meet while driving. The driver assumes the inherent hazards related to this activity. The vehicle is designed for off-road use only. MOTREC disclaims any liability for incidental or consequential damages, to include, but not be limited to, personal injury or property damage arising from vehicle misuse, lack of maintenance or any defect in the vehicle.

It is the responsibility of the Owner of the vehicle to make sure that the service technicians are properly trained as required by OSHA and ANSI-B56. Service technicians shall read, understand and follow instructions in the MOTREC manual before servicing the vehicle. Only qualified and authorized personnel shall be permitted to maintain, repair, adjust and inspect the vehicle.

MOTREC prohibits, and disclaims responsibility for, any vehicle modification altering the weight distribution and stability, increasing the speed or affecting the safety of the vehicle. Such modifications can cause serious personal injury or property damage for which MOTREC disclaims any responsibility.

For Owners that are located outside North America, the warranty period starts the date of shipment from the factory, and the defective parts must be returned at the Owner's expense to MOTREC prior to warranty repair.

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# INSTRUCTIONS

## SAFETY WARNINGS FOR OPERATORS

- FAILURE TO OBEY THE FOLLOWING SAFETY RULES MAIN RESULT IN SEVERE INJURY.
- It is the responsibility of the owner of this vehicle to train operators to ensure that they understand the operating characteristics of this vehicle, including training in vehicle stability, and obey the following safety rules and guidelines. Owner shall comply with OSHA and ASME/ANSI B56.8 & B56.9 regulations for vehicle use, safety rules, operator training and certification. Do not drive this vehicle unless you are a qualified operator.
- Do not drive this vehicle under the influence of drugs or alcohol.
- Do not drive this vehicle on public roads and highways. This vehicle is designed to be driven in buildings.
- The electrical system of this vehicle will make sparks which can ignite inflammable materials. Never use the vehicle in hazardous areas where there are inflammable materials, explosive dust or fumes in the air.
- Have your vehicle inspected regularly by trained personnel, and cease operation if a malfunction occurs.
- Do not open battery compartment to prevent battery explosion, acid splashing, severe damage to eyes or skin.
- Do not open motor compartment. Keep clear from moving, rotating(wheels, sheaves, etc) or lifting parts.
- Never carry more passengers than number allowed for this vehicle. Wait until all occupants are seated and holding on before moving. Always keep all body parts inside vehicle. Keep both hands on steering wheel.
- Do not exceed the vehicle cargo load capacity and gross trailing weight capacity, rated for flat hard even surface. Different operating conditions such as loose terrain or ramps reduce vehicle capacity.
- Avoid loose, unbalanced or top-heavy loads to keep a good stability and prevent overturn. Do not load cargo that can fall off the vehicle. Do not carry cargo that is longer, wider or higher than this vehicle.
- Always depress slowly the accelerator for smooth acceleration. Avoid stunt driving or horseplay.
- Avoid sharp turns, always slow down before turning, to prevent vehicle overturn or trailer jack knife. Vehicle is more sensitive to overturn and jack knife when traveling on inclines or when carrying a heavy load.
- Always drive straight up and down the face of an incline, never across the face, to prevent overturn and trailer jack knife. Drive slower and start applying brakes sooner on inclines to adjust for longer stopping distance.
- Use extra care and drive slowly in reverse, in congested areas or on wet or slippery ground.
- Keep to the right under normal conditions. Maintain a safe distance from all objects.
- Slow down and sound the horn when approaching a corner or other blind intersections.
- Before leaving the vehicle, park on a level ground flat surface, turn off all switches, set the forward/reverse switch to neutral, set the parking brake, remove the key. Do not park the vehicle on an incline.
- Before battery charging, park the vehicle in a well ventilated area set for. Do not operate it when charging. To interrupt a charging cycle, disconnect the AC plug; disconnecting the DC plug or a battery terminal, or operating the vehicle, could damage the charger and produce a spark, battery explosion and acid splashing.
- Use another driver to steer this vehicle while it is towed. Be sure the driver uses brakes when you slow or stop the towing vehicle. Do not exceed 5 MPH or carry any passenger while towing this vehicle.

# OPERATING INSTRUCTIONS

It is the responsibility of the owner of this vehicle to ensure that the operator understands the operating characteristics of this vehicle, and obeys the safety instructions (ANSI B56).

Do not drive this vehicle unless you are a certified operator as required by OSHA.

## BEFORE USING VEHICLE

Before turning on key switch: set to neutral, check for any visible damage, check brake pedal.

## BATTERIES

Never open the battery compartment unless you have received proper training for battery maintenance. Batteries emit explosive hydrogen gas that can be ignited by a spark or loose terminal. Battery acid causes severe damage to eyes or skin. Flush the contaminated area immediately with water.

## BATTERY CHARGER

Park the vehicle in a well ventilated area for battery charging. Most battery chargers come with an electronic control that starts when the charger is plugged and stop when the battery is fully charged. To interrupt the charging cycle, disconnect the AC-plug, do not disconnect the DC plug.

## BATTERY DISCHARGE INDICATOR

The green light moves from right to left as batteries are being discharged. When the green light is at the last position on the left the batteries must be recharged. A flashing light warns the operator that further discharge will damage batteries. See HOBBS indicator instructions

## KEYSWITCH

Depress brake pedal and turn the key switch clockwise for on position. Always turn off all switches, set the F/R selector to neutral, set the parking brake, remove the key before leaving the vehicle.

## HORN

Depress the horn button on the steering column or handle bar.

## F/R SWITCH

Three positions with neutral at center. Depress the front part of the rocker switch for forward direction. Depress the rear part of the rocker switch for reverse direction. Always set switch to neutral, turn off all switches, set the parking brake, remove the key before leaving the vehicle.

## ACCELERATOR PEDAL

It is designed for right foot operation only, and controls the speed of the vehicle.

## FOOT BRAKE PEDAL

It is designed for right foot operation only. The brake force is proportional to the pressure on the pedal.

## PARKING BRAKE

Pull handbrake lever to apply. Never park the vehicle on an incline. Always turn off all switches, set the F/R selector to neutral, set the parking brake, remove the key before leaving the vehicle.

# MAINTENANCE

## SAFETY WARNINGS FOR SERVICE TECHNICIANS

FAILURE TO OBEY THE FOLLOWING SAFETY RULES MAIN RESULT IN SEVERE INJURY.

Owner shall comply with OSHA and ASME/ANSI B56.8 & B56.9 regulations for vehicle maintenance.

Only qualified and authorized personnel shall be permitted to maintain, repair, adjust and inspect carriers, vehicles, tractors, and batteries.

Before any maintenance work, park the vehicle on flat level surface, turn off all switches, remove key, lift wheels off the ground and secure with jack stands of adequate capacity. Don't connect charger.

Keep clear from moving parts such as tires, sheaves and motor.

Follow the maintenance instructions applicable to the type of repair, maintenance, or service.

Always wear a face shield and gloves when working around batteries.

Before opening the battery compartment, disconnect the charger, turn off all switches and remove the key. Batteries emit highly explosive gases which greatly increase when charging; do not disturb connections or produce sparks around batteries to avoid a battery explosion and acid splashing. Battery acid causes severe damage to eyes or skin. Flush contaminated area immediately with water.

Use insulated tools to avoid sparks that can cause battery explosion and acid splashing.

Use two counteracting tools, double-wrench technique, when disconnecting or tightening terminals on the battery and the speed controller to avoid cracking the terminal or battery post welds.

Before cleaning or replacing a battery, charger, speed controller, contactor, relay, diode, or any other component in the power circuit, always disconnect the charger, turn off all switches, remove the key, wear a face shield and gloves, identify battery polarity and disconnect battery leads, discharge the capacitor in the controller with a 10 ohms, 25 W resistor for a few seconds across B+ and B-.

After cleaning, the power must not be reapplied until terminal areas are thoroughly dry.

On EE-Rated vehicles make sure that the control box is sealed, the static strap makes good contact with the ground, the motor is sealed by bands, the cable protectors are properly installed.

Keep cables and wires clear from mechanical and rubbing action. Make sure that cable insulation is free from cutting or visible damage. Make sure that EE-Rated cable protectors are properly installed.

Before replacing a fuse or circuit breaker, identify the cause of failure and repair.

Programmable controllers must be programmed using the parameter settings in this service manual, before connecting the motor, to avoid sudden vehicle movement and accident.

Do not try to increase motor speed by changing parameter settings in the speed controller; it can cause accident and severe damage to the motor.

SEPEX speed controls are protected by a diode in the power circuit to filter inductive loads in the event of a sudden power interrupt. Some speed controllers require a diode to filter inductive loads on the KSI input. Removing the diodes will cause the speed control failure.

Before resuming maintenance operations, inspect safety warnings stickers and replace any if damage is found and part of the text can’t be read.

## DECALS AND LABELS

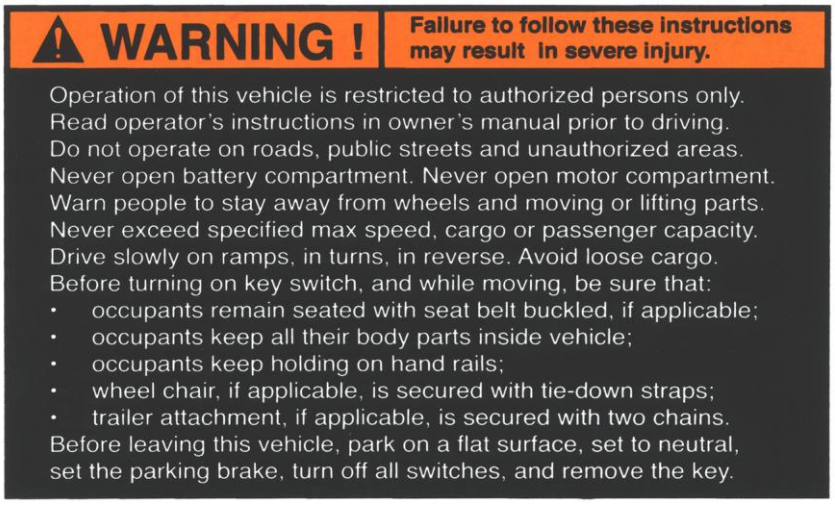
**! CAUTION !**

The images included in this section depict the decals/markings installed on the vehicle. It is of the utmost importance that theses decals/markings remain unaltered and readable. Else, the sticker or the part baring the marking has to be replaced.

Dashboard security warning label:

WARNING !
Failure to follow these instructions may result in severe injury.
Operation of this vehicle is restricted to authorized persons only.
Read operator's instructions in owner's manual prior to driving.

General security warning label:


WARNING !
Failure to follow these instructions may result in severe injury.
Operation of this vehicle is restricted to authorized persons only.
Read operator's instructions in owner's manual prior to driving.
Do not operate on roads, public streets and unauthorized areas.
Never open battery compartment. Never open motor compartment.
Warn people to stay away from wheels and moving or lifting parts.
Never exceed specified max speed, cargo or passenger capacity.
Drive slowly on ramps, in turns, in reverse. Avoid loose cargo.
Before turning on key switch, and while moving, be sure that:
• occupants remain seated with seat belt buckled, if applicable;
• occupants keep all their body parts inside vehicle;
• occupants keep holding on hand rails;
• wheel chair, if applicable, is secured with tie-down straps;
• trailer attachment, if applicable, is secured with two chains.
Before leaving this vehicle, park on a flat surface, set to neutral,
set the parking brake, turn off all switches, and remove the key.

Respectively, key switch markings, forward/reverse selector markings and light switch marking:

# PERIODIC MAINTENANCE CHECKLIST

**! WARNING !**

Maintenance operations must be made by properly trained service technicians.

- Keep clear from moving parts such as tires, sheaves and motor.
- Check for all EE protections, when applicable, and keep cables and wires clear from mechanical and rubbing action
- Batteries contain sulphur acid that can cause severe burns on skin or eyes.
- When working around batteries, wear acid proof protective equipment: face shield and gloves.
- Use electrically insulated tools to avoid sparks that can cause battery explosion.
- Before any maintenance work, park the vehicle on a flat level surface, turn off all switches, remove the key, lift the wheels off the ground and secure with jack stands of adequate capacity, identify and disconnect battery leads. Don't connect the charger.

| **CHECK/PERFORM** **PERIOD HOURS** | **DAY** | **WEEK 20** | **MONTH 50** | **QUART. 200** | **YEAR 1000** | **2 YEARS 2000** |
|---|---|---|---|---|---|---|
| MECHANICAL DAMAGE, OIL LEAKS | **X** | | | | | |
| REVERSE ALARM, DEADMAN SWITCH | **X** | | | | | |
| STATIC STRAP, min 2" contact with ground | **X** | | | | | |
| TIRE PRESSURE, pressure rating on tire | | **X** | | | | |
| CHECK/FILL BATTERIES, add distilled water to cover plates. Fill to recommended level after batteries have been fully charged. | | **X** | | | | |
| WARNING DECALS & MARKINGS | | | **X** | | | |
| EE-Rated CABLE PROTECTORS, SEALED MOTOR, SEALED CONTROL BOX, STATIC STRAP. | | | **X** | | | |
| MASTER CYLINDER FLUID (DOT 3) | | | **X** | | | |
| BRAKE PEDAL TRAVEL<br>2" (50 mm) maximum travel | | | **X** | | | |
| STEERING FOR PLAY | | | **X** | | | |
| PARKING BRAKE LEVER<br>requires 10 lbs. (5 kg) force to apply | | | **X** | | | |
| BELTS AND PULLEYS<br>-10 lbs (5kg). force for 1/8" (3mm) deflexion;<br>-pulleys alignment, see procedure. | | | | **X** | | |
| CLEAN/TIGHTEN WIRE TERMINALS | | | | **X** | | |
| WASH BATTERY TOP WITH WATER | | | | **X** | | |
| MOTOR BRUSHES FOR WEAR<br>-brushes must exceed holders | | | | **X** | | |
| ACCELERATOR ADJUSTMENT<br>-1/8" (3 mm) travel to activate micro-switch;<br>-0 to 50 ohms when micro-switch activated;<br>-4500 to 5500 ohms with pedal down. | | | | **X** | | |
| HYDR. BRAKE LINES FOR LEAK | | | | **X** | | |
| STEERING ASSEMBLY, as instructed | | | | **X** | | |
| BRAKE MECHANICAL LINKAGES<br>for wear & play | | | | **X** | | |
| BRAKE LININGS FOR WEAR<br>1/16" (1.5 mm) minimum lining thickness. | | | | **X** | | |
| LUBRICATE brake pedal pivots, steering column, ball joints and kingpins. | | | | **X** | | |
| OIL (SAE 30) LEVEL IN DIFFERENTIAL<br>Before adding oil, check oil seals for leaks. | | | | **X** | | |
| FRONT WHEEL BEARINGS PLAY | | | | **X** | | |
| TIGHTEN NUTS/BOLTS, electric terminals; drive; steering; brakes; suspension; body. | | | | **X** | | |
| REPLACE DIFFERENTIAL OIL(SAE 30) | | | | | **X** | |
| CLEAN AND RE-PACK FRONT HUBS | | | | | **X** | |
| SERVICE DIFFERENTIAL, replace the three oil seals, wheel bearings, oil (SAE 30) | | | | | | **X** |

# ACCELERATOR

## GEAR

- Remove the cover.
- Backlash between gears must be reduced to a minimum by sliding holder; use locktite 262 to lock the three screws.
- When the plastic gear is fully depressed a small backlash must remain between the gears.
- When the plastic gear is released its rear portion must not exceed the pedal case.

## MICRO-SWITCH

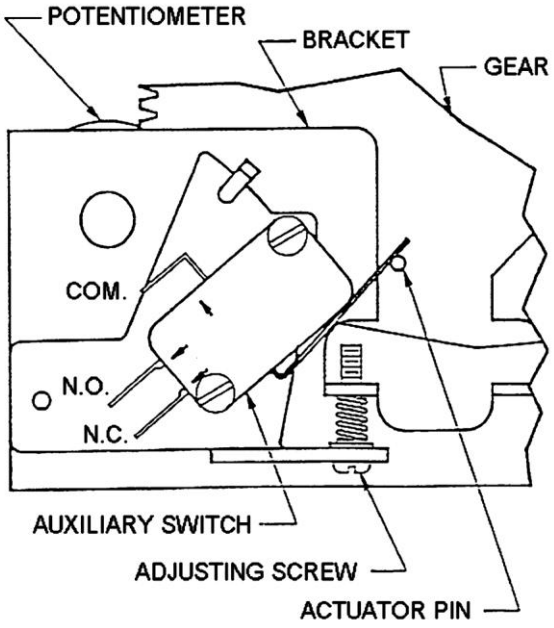
The micro-switch must deactivate the on/off solenoid when the accelerator is released; turn the adjusting screw (shown on figure below) to adjust the micro-switch height.

## POT

- Remove the terminals 2 and 3 on PMC to measure resistance signal.
- When the micro-switch is activated the signal must be less than 50 ohms. When the front portion of the pedal is fully depressed the signal must be more than 4600 ohms.
- To modify the resistance, turn the adjusting screw to change the micro-switch height (see figure below).

Proceed with the same verifications after the accelerator cover is on and then connect terminals 2 and 3.

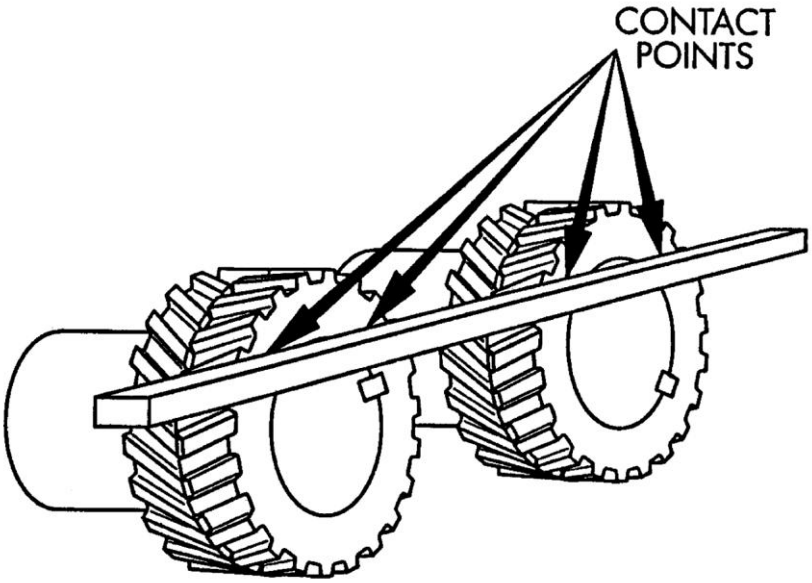
AUXILIARY SWITCH IS WIRED N.O. WITH BLUE LEAD TO COM. & ORANGE LEAD TO N.O. CIRCUIT. THE GREEN LEAD IS GROUNDED. AUXILIARY SWITCH IS SHOWN WITH THE TREADLE IN THE UP POSITION. SWITCH WILL ACTUATE AT BEGINNING OF TREADLE STROKE. SYMBOLS COM., N.O. & N.C. ARE TERMINAL MARKINGS, AS MARKED ON SWITCH.



## BELT INSTALLATION AND TENSIONING

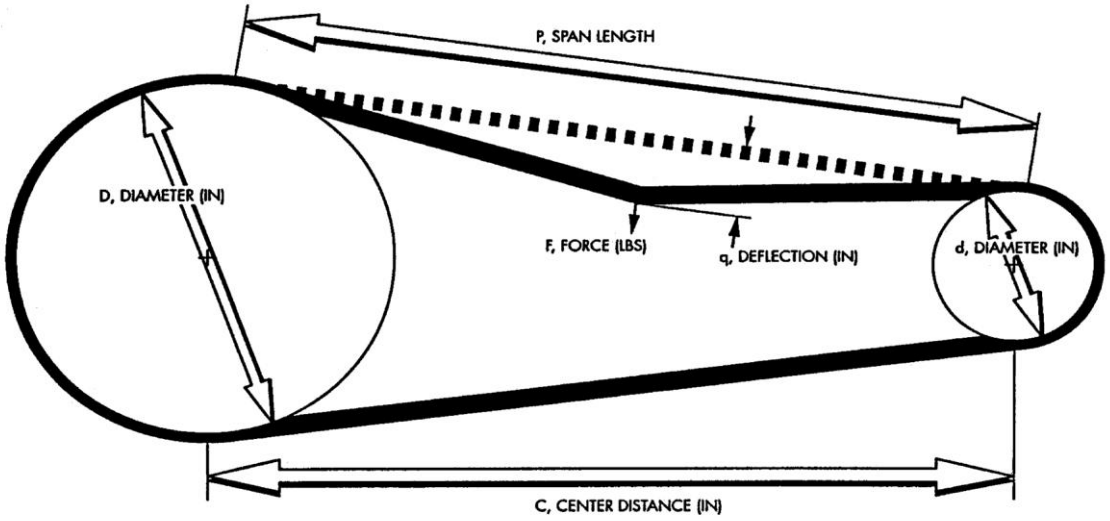
### INSTALLATION

Adjust the sprockets using a straight edge. Slide up the edge on the larger pulley until it contacts the smaller pulley. Properly adjusted pulleys will provide three points of contact. Properly aligned pulleys will provide four points of contact. Tighten setscrews and recheck alignment.




### TENSIONING

Check the force F required to provide a deflection of 1/8 in. If the measured force is less than 15 lbs then lengthen centre distance C.



# HYDRAULIC BRAKES

## DRUM BRAKES

Remove brake drums and check linings wear; the linings should have a thickness exceeding 1/16" (1.5 mm). Turn the brake adjustment to reduce the clearance between lining and drum but avoid contact or drag when the wheels are turned and the pedal is released.

## DISC BRAKES

Check pad linings for excessive wear; the linings should have a thickness exceeding 1/16" (1.5 mm). Disc brakes are self-adjusting.

## BRAKE PEDAL

If the brake pedal becomes soft or spongy, air may have entered the hydraulic system and the brake system has to be bled:

1. fill the master cylinder with brake fluid (DOT-3);
2. bleed front callipers one at a time by having someone applying a steady pressure on the brake pedal, and close the bleeder before allowing the brake pedal to return to up position;
3. fill the master cylinder with brake fluid (DOT-3);
4. bleed rear wheel brakes one at a time, following the same procedure;
5. fill the master cylinder with brake fluid (DOT-3);
6. clean every fitting and line, remove traces of oil;
7. apply a continuous pressure on the brake pedal for about five minutes ;
8. Finally, inspect brake lines and fittings for leaks ;

# FRONT AXLE AND STEERING

**! CAUTION !**

Before maintenance, turn off all switches, set to neutral, set parking brake, remove the key, and raise the front end of the vehicle supporting it with two jack stands of adequate capacity

## STEERING INSPECTION

– Check tire inflation pressure, suspension components, tie rods straightness, tie rod ends play (wear), play (wear) in wheel bearings, kingpins and bushings.

## REPLACING & ADJUSTING THE STEERING GEAR

– Remove the pitman arm;
– The steering box makes 6.5 turns, center the steering gear (3.25 turns from either side);
– Align the front wheel straight. Install the pitman arm.

## TOE-IN ADJUSTEMENT

– With the wheels in straight forward direction, measure the inside (left to right) distance between the front tires, at the front and rear of the tires;
– Turn the rear tie rod until the distances are equal and tighten the two lock nuts on the tie rod.

## REMOVING & GREASING OF FRONT HUBS, required once-a-year

– Remove dust cap and cutter pin, unscrew nut, remove hub;
– Inspect bearings and races for wear and replace worn bearings;
– Replace the seal;
– Pack the hub with wheel bearing grease and re-assemble.

## ADJUSTING FRONT HUBS

– Tighten spindle nut to 30 ft-lb to seat the bearing and back off the nut to the next slot;
– Install a new cutter pin and the dust cap.

# BATTERY MAINTENANCE

**! WARNING !**

- It is the responsibility of the owner of this vehicle to ensure that the service technicians are properly trained, read and obey the safety rules and guidelines in this manual (ANSI B56).
- Maintenance operations must be made by properly trained service technicians only.
- Before any maintenance work, park the vehicle on a flat level surface, turn off all the switches, set to neutral, remove the key, lift the wheels off the ground and secure with jack stands of adequate capacity.
- Keep charger disconnected while doing any maintenance work.
- Always wear a face shield and scarf when working around batteries.
- Battery emits highly explosive gases; do not produce sparks to avoid battery explosion and acid splashing. Battery acid causes severe damage to eyes or skin. Flush contaminated area immediately with water.
- Use insulated tools to avoid sparks that can cause battery explosion and acid splashing.
- Use two counteracting tools, double-wrench technique, when disconnecting or tightening battery posts.
- Before cleaning or replacing a battery, discharge the capacitor in the controller with a 10 ohms, 25 W resistor for a few seconds across B+ and B-, identify battery polarity and disconnect battery leads.
- After cleaning, the power must not be reapplied until terminal areas are thoroughly dry.

## BATTERY LEADS AND CONNECTORS

Check for loose connections, damaged cables, acid spill, loose terminal posts, quarterly.

## BATTERY POST CORROSION

If corrosion is present on battery posts, remove the cable connectors, use a wire brush to remove particles, and then clean them with a cloth that has been moistened with ammonia.

## ELECTROLYTE LEVEL

Does not apply to sealed battery.

- Disconnect battery connectors on roll-out or lift-out installations.
- Make sure the battery roll-out tray is provided with stops before rolling out.
- Fill with distilled water.
- Daily charged batteries normally require watering once a week. Under watering leads to a shortened battery life. Over watering leads to battery corrosion. Be careful not to overfill any cell to avoid electrolyte to be forced out while charging.
- Fill each cell to plate level with distillated or de-ionized water, before battery charging. When the battery is charged, the fluid expands and can seep out if overfilled. Refill each cell after full charge, when the fluid has expanded to its maximum level.
- Reinstall battery caps before charging.

## BATTERY MOUNTING

A loose battery increases damaging effects of vibrations and is more prone to short out.

## BATTERY DISCHARGE LIMIT

Discharging below a 20% state of charge cuts down the battery life and the number of cycles available. At 20% state of charge, specific gravity of 6V battery should be 1180; and 1220 for industrial battery.

## CHARGING AREA

- Always charge battery in a well ventilated area set for and approved for charging.
- Never leave a charger connected for more than 20 hours.

## FREQUENCY OF CHARGE

- When a battery is discharged to its 20% state of charge, it is best to charge immediately.
- Batteries require a low current equalization charge (min 4 hours) at least every week, to equalize battery cells, improve battery performance and life in number of cycles.
- Never leave a charger connected for more than 20 hours.

## STORAGE

- Keep the battery from getting cold, it would loose its capacity.
- Let the battery warm up before charging.
- Charge batteries in “stored” vehicles every month.

## DEFECTIVE BATTERY

Check specific gravity of each cell; if a cell is shorted, voltage drop may occur only when there is current.

## BATTERY CHARGER

**! WARNING !**

Always unplug the AC and DC electrical cords before attempting any repairs to the charger.

**CHARGER DOES NOT TURN ON:**

- Dc cord of portable chargers must be disconnected from batteries after every charge to restart;
- Check dc fuse links;
- Check battery voltage at the battery connector;
- Check ac outlet and cordset;
- Replace electronic control ;

**RELAY CLOSES AND TRANSFORMER HUMS BUT AMMETER DOES NOT REGISTER:**

- Check dc fuse links;
- Check the continuity of the dc output cord, ammeter, diodes and all connections in the dc circuit;
- Check diodes;
- Check capacitor(rapidely increasing resistance);

**SINGLE CHARGER FUSE BLOWS:**

- Disconnect and check diodes;

**BOTH FUSE LINKS BLOW:**

- Check the battery pack and battery connector polarity;
- Disconnect and check diodes.

**CHARGER OUTPUT IS LOW:**

- Disconnect and check diodes;
- Can be caused by a transformer failure.

**AMMETER READS 30 AMPS FOR MORE THAN 30 MINUTES:**

- Check the battery pack;

**CHARGER DOES NOT TURN OFF:**

- Check specific gravity in each battery cell;
- As much as 16 hours may be required to properly charge heavely discharged new or cold batteries;
- Replace electronic control.

**AC LINE FUSE OR CIRCUIT BREAKER BLOWS:**

- Check ac cordset;
- Check ac line fuse rating;
- Replace electronic control;
- Can be caused by a transformer failure.

# ELECTRICAL TROUBLESHOOTING

**! WARNING !**

Maintenance work must be performed by trained service technicians only.

It is the responsibility of the owner of this vehicle to ensure that the services technicians are properly trained, understand and obey the safety rules and guidelines (ANSI B56).

All service technicians must read and understand the maintenance warning section in this manual.

**! WARNING !**

Before any maintenance work, park the vehicle on a flat level surface, turn off all switches, remove the key, lift the wheels off the ground, secure with jack stands of adequate capacity, disconnect charger.

Always wear safety glasses.

Batteries emit highly explosive gases that can be ignited by a spark. Before disconnecting a high current terminal, turn off all switches, disconnect battery charger, disconnect batteries.

Keep clear from moving parts such as tires, sheaves and motor.

## PMC SELF DIAGNOSTIC

If your PMC comes with a status led, use the flashing code to help troubleshooting.

## BATTERY VOLTAGE

Make sure batteries are securely connected. Measure voltage between + and - terminals. We will call this value B+ or full battery voltage.

## ACCESSORIES NOT WORKING

- Check the fuses on the batteries and the DC/DC converter.
- Check voltage across + and – terminals on the battery gage; if not B+, check wiring.
- Turn the key switch ON, check voltage between output terminal on the key switch and the - terminal on the battery gage; if not B+, replace the key switch.
- Check voltage across DC/DC converter output terminals; if not 12-Volt, replace the converter.
- Depress the accessory switch, check voltage across accessory terminals. If not 12-Volt, replace the switch. If 12-Volt, replace the accessory.

## FORWARD ONLY

On a SEPEX motor control, check the reverse signal input on the controller.
On a series wound motor control, a bad reverse contactor is the most probable cause of the problem. Switch to reverse and check voltage on the reverse control wire. If not B+, replace the F/R switch. If B+, turn off the key switch, disconnect batteries, disconnect power terminals on the F/R contactors, check the resistance across N.C. power terminals of the reverse contactor. If not 0 ohm, change the reverse contactor. If 0 ohms, switch to forward and check the resistance across the forward N.O. power terminals. If not 0 ohms, change the forward contactor.

## REVERSE ONLY

On a SEPEX motor control, check the forward signal input on the controller.
On a series wound motor control, a bad forward contactor is the most probable cause of the problem. Switch to forward and check the voltage on the forward control wire. If not B+, replace the F/R switch. If B+, turn off the key switch, disconnect batteries, disconnect power terminals on the F/R contactors, check the resistance across N.C. power terminals of the forward contactor. If not 0 ohm, change the forward contactor. If 0 ohms, switch to reverse and check the resistance across the reverse N.O. power terminals. If not 0 ohms, change the reverse contactor.

## TRAVEL AT REDUCED SPEED

*Check batteries.*

Turn off all switches and disconnect charger. Wear face shield and gloves. Do not disturb any battery connection to avoid sparks. Check the specific gravity of each cell. Cold batteries, highly discharged batteries or dead cells are the most frequent causes of reduced travel speed.

*Check potentiometer.*

Turn off the key switch, disconnect potentiometer terminals. Check the resistance between terminals.

Other causes of lower speed:
- dragging brakes;
- cold temperature (higher differential oil viscosity).

## INTERMITTENT OPERATION

A bad potentiometer is the most probable cause of the following:
- acceleration is not constant;
- maximum speed is erratic;
- sudden stop after a bump or shock;
- erratic starts, requiring several pedal cycles.

A bad F/R contactor is also a probable cause of the following:
- sudden stop after a bump or shock;
- would not start to move at times.

Erratic starts could also be the cause of a misadjusted potentiometer or micro-switch; the pot signal must be less than 50 ohms when the micro-switch turns on.

PMC has an HPD safety feature that prevents the vehicle from moving if the accelerator pedal is depressed before the key switch is ON and seat switch is activated.

PMC may also have an SRO safety feature that prevents the vehicle from moving if the F/R switch is activated before turning on the key switch and activating the seat switch.

The vehicle stops on a steep and long ramp or while towing a heavy load: the circuit breaker has open to prevent motor overheating and will reset automatically after one minute. The PMC is also equipped with an internal thermal protection that cutback the current until the PMC has cooled down.

## NO MOTION

Make sure that the PMC surface is clean and dry; check the terminal areas. Dust Particles or acid contamination, can create current leaks and cause a PMC malfunction.

*Check F/R switch*

Turn on the key switch and set to forward. Check voltage between the forward terminal and the – terminal on the battery gage, check voltage between the reverse terminal and the – terminal on the battery gage; if both B+, replace the F/R switch.

*Check switches and wiring*

Disconnect control terminals on the PMC and check all control signals. If a switch pin does not read B+, check wiring or replace the switch.

*Check potentiometer*

Turn the key switch to OFF, disconnect potentiometer terminals. Check the resistance across terminals: if not within the recommended limits, adjust or replace the potentiometer. Check for shorts between potentiometer wires and vehicle frame; resistance should read at least 1 megohm.

*Check main contactor or solenoid*

Check voltage across power terminals; if not B+, check circuit breaker or replace the solenoid.
Turn to on the key switch and activate the seat switch. Check voltage across the coil terminals; if not B+, check wiring and interlock switches. Check resistance across power terminals; if not 0 ohms, replace the solenoid.

*Check circuit breaker and SEPEX DIODE*

Before replacing the circuit breaker, check for shorts in the power circuit and check the SEPEX diode in the power circuit using a diode tester. If no such instrument is at hand, use an ohmmeter: the reading should be weak in one direction and strong in the other way.
Check the resistance across the circuit breaker. If not 0 ohms, replace the circuit breaker.

*Check PMC*

First disconnect battery B+ and B-, then PMC B+ and M-. Check the internal diode between B+ and M- terminals using a diode tester. If no such instrument is at hand, use an ohmmeter: the reading should be weak in one direction and strong in the other way. If the internal diode is defective, the PMC must be replaced.

*Check the Motor*

First disconnect battery B+ and B-, disconnect power terminals and check the motor armature and field for opens.

# CURTIS SPEED CONTROLLER

# MANUAL

CURTIS PMC

MODEL **1244**

**MultiMode™**
**MOTOR CONTROLLER**

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DESIGN OF CURTIS PMC 1200 SERIES CONTROLLERS PROTECTED BY U.S. PATENT NO. 4626750.

1244 Manual, p/n 16958
Rev. B: January 2001

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1244 Manual
p/n 16958, Rev. B: January 2001

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## WIRING: Standard Configuration

Figure 3 shows the typical wiring configuration for most applications. The interlock switch is typically a seat switch, tiller switch, or foot switch.

### Standard Power Wiring

Motor armature winding is straightforward, with the armature's A1 connection going to the controller's B+ bus bar and the armature's A2 connection going to the controller's M- bus bar.

The motor's field connections (**F1** and **F2**) to the controller are less obvious. The direction of vehicle travel with the forward direction selected will depend on

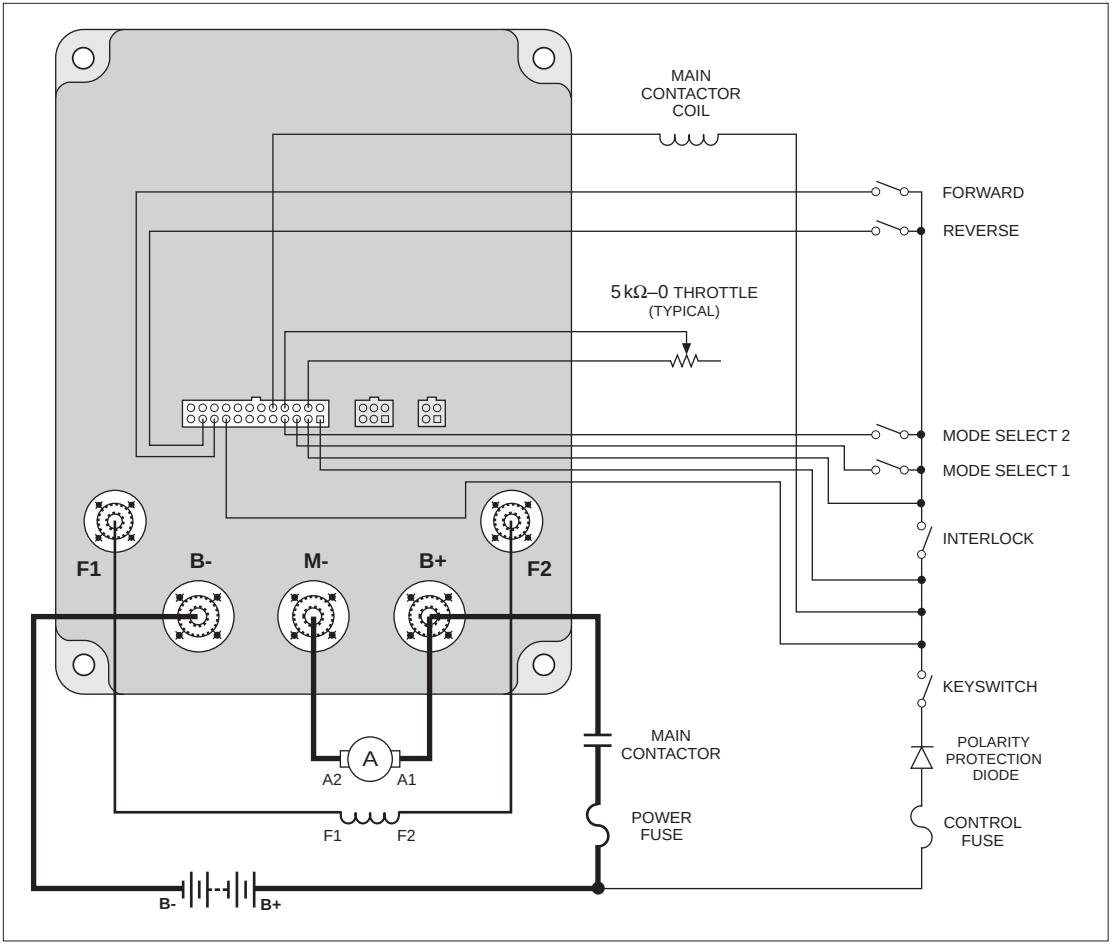



**Fig. 3** *Standard wiring configuration, Curtis PMC 1244 controller.*

# 8 DIAGNOSTICS AND TROUBLESHOOTING

The 1244 controller provides diagnostics information to assist technicians in troubleshooting drive system problems. The diagnostics information can be obtained by observing the appropriate display on the handheld programmer, the fault codes issued by the Status LED, or the fault display driven by the controller's Fault 1 and Fault 2 outputs. Refer to the troubleshooting chart (Table 5) for suggestions covering a wide range of possible faults.

## PROGRAMMER DIAGNOSTICS

The programmer presents complete diagnostic information in plain language. Faults are displayed in the Diagnostic Menu (see column 2 in the troubleshooting chart), and the status of the controller inputs/outputs is displayed in the Test Menu.

Accessing the Diagnostic History Menu provides a list of the faults that have occurred since the diagnostic history file was last cleared. Checking (and clearing) the diagnostic history file is recommended each time the vehicle is brought in for maintenance.

The following 4-step process is recommended for diagnosing and troubleshooting an inoperative vehicle: (1) visually inspect the vehicle for obvious problems; (2) diagnose the problem, using the programmer; (3) test the circuitry with the programmer; and (4) correct the problem. Repeat the last three steps as necessary until the vehicle is operational.

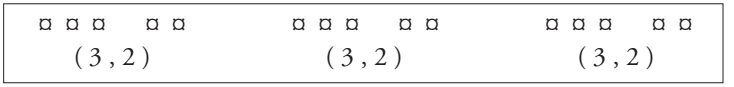
> **Example:** A vehicle that does not operate in "forward" is brought in for repair.
>
> STEP 1: Examine the vehicle and its wiring for any obvious problems, such as broken wires or loose connections.
>
> STEP 2: Connect the programmer, select the Diagnostics Menu, and read the displayed fault information. In this example, the display shows "No Known Faults," indicating that the controller has not detected anything out of the norm.
>
> STEP 3: Select the Test Menu, and observe the status of the inputs and outputs in the forward direction. In this example, the display shows that the forward switch did not close when "forward" was selected, which means the problem is either in the forward switch or the switch wiring.
>
> STEP 4: Check or replace the forward switch and wiring and repeat the test. If the programmer shows the forward switch closing and the vehicle now drives normally, the problem has been corrected.

## Table 5 TROUBLESHOOTING CHART

| LED CODE | PROGRAMMER LCD DISPLAY | FAULT CATEGORY | EXPLANATION | POSSIBLE CAUSE |
|---|---|---|---|---|
| 1,2 | HW FAILSAFE1-2-3 | 1 | self-test or watchdog fault | 1. Controller defective. |
| 1,3 | M- SHORTED | 1 | internal M- short to B- | 1. Controller defective. |
| | FIELD OPEN | 1 | field winding fault | 1. Motor field wiring loose.<br>2. Motor field winding open. |
| | ARM SENSOR | 1 | armature current sensor fault | 1. Controller defective. |
| | FLD SENSOR | 1 | field current sensor fault | 1. Controller defective. |
| 2,1 | THROTTLE FAULT 1 | 1 | wiper signal out of range | 1. Throttle input wire open.<br>2. Throttle input wire shorted to B+ or B-. |
| | THROTTLE FAULT 2 | 1 | pot low fault | 1. Throttle pot defective.<br>2. Wrong throttle type selected. |
| 2,2 | SRO | 3 | SRO fault | 1. Improper sequence of KSI, interlock, and direction inputs.<br>2. Wrong SRO type selected.<br>3. Interlock or direction switch circuit open.<br>4. Sequencing delay too short. |
| 2,3 | HPD | 3 | HPD fault | 1. Improper seq. of direction and throttle inputs.<br>2. Wrong HPD type selected.<br>3. Misadjusted throttle pot.<br>4. Sequencing delay too short. |
| 2,4 | BB WIRING CHECK | 1 | emergency reverse wiring fault | 1. Emergency reverse wire open.<br>2. Emergency reverse check wire open. |
| 3,1 | CONT DRVR OC | 1 | cont. driver output overcurrent | 1. Contactor coil shorted. |
| 3,2 | MAIN CONT WELDED | 1 | welded main contactor | 1. Main contactor stuck closed.<br>2. Main contactor driver shorted. |
| 3,3 | PRECHARGE FAULT | 1 | internal voltage too low at startup | 1. Controller defective.<br>2. External short, or leakage path to B- on external B+ connection. |
| 3,4 | MISSING CONTACTOR | 1 | missing contactor | 1. Any contactor coil open or not connected. |
| | MAIN CONT DNC | 1 | main contactor did not close | 1. Main contactor missing or wire to coil open. |
| 4,1 | LOW BATTERY VOLTAGE | 2 | low battery voltage | 1. Battery voltage <undervoltage cutback limit.<br>2. Corroded battery terminal.<br>3. Loose battery or controller terminal. |
| 4,2 | OVERVOLTAGE | 2 | overvoltage | 1. Battery voltage >overvoltage shutdown limit.<br>2. Vehicle operating with charger attached.<br>3. Battery disconnected during regen braking. |
| 4,3 | THERMAL CUTBACK | 2 | over-/under-temp. cutback | 1. Temperature >85°C or < -25°C.<br>2. Excessive load on vehicle.<br>3. Improper mounting of controller.<br>4. Operation in extreme environments. |
| 4,4 | ANTI-TIEDOWN | 3 | Mode 2 or Mode 4 selected at startup | 1. Mode switches shorted to B+.<br>2. Mode switches “tied down” to select Mode 2 or Mode 4 permanently. |

## LED DIAGNOSTICS

A Status LED is built into the 1244 controller. It is visible through a window in the label on top of the controller. This Status LED displays fault codes when there is a problem with the controller or with the inputs to the controller. During normal operation, with no faults present, the Status LED flashes steadily on and off. If the controller detects a fault, a 2-digit fault identification code is flashed continuously until the fault is corrected. For example, code "3,2"—welded main contactor—appears as:




The codes are listed in Table 6.

**Table 6 STATUS LED FAULT CODES**

| LED CODES | | EXPLANATION |
|---|---|---|
| *LED off* | ▬▬▬▬ | no power or defective controller |
| *solid on* | ▭▭▭▭ | controller or microprocessor fault |
| 0,1 | ■ ¤ | controller operational; no faults |
| 1,1 | ¤ ¤ | [not used] |
| 1,2 | ¤ ¤¤ | hardware failsafe fault |
| 1,3 | ¤ ¤¤¤ | M-, current sensor, or motor fault |
| 1,4 | ¤ ¤¤¤¤ | [not used] |
| 2,1 | ¤¤ ¤ | throttle fault |
| 2,2 | ¤¤ ¤¤ | static return to off (SRO) fault |
| 2,3 | ¤¤ ¤¤¤ | high pedal disable (HPD) fault |
| 2,4 | ¤¤ ¤¤¤¤ | emergency reverse circuit check fault |
| 3,1 | ¤¤¤ ¤ | contactor driver overcurrent |
| 3,2 | ¤¤¤ ¤¤ | welded main contactor |
| 3,3 | ¤¤¤ ¤¤¤ | precharge fault |
| 3,4 | ¤¤¤ ¤¤¤¤ | missing contactor, or main cont. did not close |
| 4,1 | ¤¤¤¤ ¤ | low battery voltage |
| 4,2 | ¤¤¤¤ ¤¤ | overvoltage |
| 4,3 | ¤¤¤¤ ¤¤¤ | thermal cutback, due to over/under temp. |
| 4,4 | ¤¤¤¤ ¤¤¤¤ | anti-tiedown fault |

NOTE: Only one fault is indicated at a time, and faults are not queued up. Refer to the troubleshooting chart (Table 5) for suggestions about possible causes of the various faults.

## PROGRAMMING PARAMETERS – E-290HD, E-348, E-480, E-500, E-660, T-248, T-448

**! WARNING !**

The owner of this vehicle shall ensure that the service technicians are qualified, properly trained and obey the safety rules and guidelines in OSHA and ANSI B56 regulations, and in this manual.

Before installing and/or programming the PMC, park the vehicle on a flat level surface, lift the wheels off the ground and secure with jack stands of adequate capacity. Don't connect charger.

Programmable controllers must be programmed using the parameter settings in this service manual, before connecting the motor, to avoid sudden vehicle movement and accident.

Do not try to increase motor speed by changing parameter settings in the speed controller; it can cause accident and severe damage to the motor.

| | | |
|---|---|---|
| VOLTAGE | NOMINAL BATTERY VOLTAGE, IN VOLTS | 4 |
| M1 DRIVE C/L | MODE 1 DRIVE CURRENT LIMIT, IN AMPS | 300 |
| M2 DRIVE C/L | MODE 2 DRIVE CURRENT LIMIT, IN AMPS | 300 |
| M3 DRIVE C/L | MODE 3 DRIVE CURRENT LIMIT, IN AMPS | 300 |
| M4 DRIVE C/L | MODE 4 DRIVE CURRENT LIMIT, IN AMPS | 300 |
| M1 BRAKE C/L | MODE 1 BRAKING CURRENT LIMIT, IN AMPS | 150 |
| M2 BRAKE C/L | MODE 2 BRAKING CURRENT LIMIT, IN AMPS | 150 |
| M3 BRAKE C/L | MODE 3 BRAKING CURRENT LIMIT, IN AMPS | 150 |
| M4 BRAKE C/L | MODE 4 BRAKING CURRENT LIMIT, IN AMPS | 150 |
| M1 THRT BRK % | MODE 1 THROT. BRAKING, AS % OF BRAKE C/L | 50 |
| M2 THRT BRK % | MODE 2 THROT. BRAKING, AS % OF BRAKE C/L | 50 |
| M3 THRT BRK % | MODE 3 THROT. BRAKING, AS % OF BRAKE C/L | 50 |
| M4 THRT BRK % | MODE 4 THROT. BRAKING, AS % OF BRAKE C/L | 50 |
| M1 ACCEL RATE | MODE 1 ACCELERATION RATE, IN SEC. | 4 |
| M2 ACCEL RATE | MODE 2 ACCELERATION RATE, IN SEC. | 4 |
| M3 ACCEL RATE | MODE 3 ACCELERATION RATE, IN SEC. | 4 |
| M4 ACCEL RATE | MODE 4 ACCELERATION RATE, IN SEC. | 4 |
| DECEL RATE | DECELERATION RATE, IN SEC. | 2.5 |
| M1 BRAKE RATE | MODE 1 BRAKING RATE, IN SEC. | 3 |
| M2 BRAKE RATE | MODE 2 BRAKING RATE, IN SEC. | 3 |
| M3 BRAKE RATE | MODE 3 BRAKING RATE, IN SEC. | 3 |
| M4 BRAKE RATE | MODE 4 BRAKING RATE, IN SEC. | 3 |
| QUICK START | QUICK START THROTTLE FACTOR | 1 |
| TAPER RATE | Regen brak. Decrease rate when apporch. 0spd, 1/32s | 32 |
| M1 MAX SPEED | MODE 1 MAX. SPEED, AS % PWM OUTPUT | 40 |
| M2 MAX SPEED | MODE 2 MAX. SPEED, AS % PWM OUTPUT | 100 |
| M3 MAX SPEED | MODE 3 MAX. SPEED, AS % PWM OUTPUT | 40 |
| M4 MAX SPEED | MODE 4 MAX. SPEED, AS % PWM OUTPUT | 40 |
| M1 CREEP SPEED | MODE 1 CREEP SPEED, AS % PWM OUTPUT | 0 |
| M2 CREEP SPEED | MODE 2 CREEP SPEED, AS % PWM OUTPUT | 0 |
| M3 CREEP SPEED | MODE 3 CREEP SPEED, AS % PWM OUTPUT | 0 |
| M4 CREEP SPEED | MODE 4 CREEP SPEED, AS % PWM OUTPUT | 0 |
| REGEN SPEED | Min. speed for regen braking, as % of vehicle speed | 25 |
| CTRL MODE | CONTROL MODE | 1 |
| THROTTLE TYPE | THROTTLE TYPE | 3 |

| | | |
|---|---|---|
| THRO. DEADBAND | Thr. Neutral deadband % of 5kohms pot | 6 |
| THROTTLE MAX | Thr. Input req`d for 100%PWM %5kohm pot | 90 |
| M1 THRTL MAP | MODE 1 THROTTLE MAP, AS % | 30 |
| M2 THRTL MAP | MODE 2 THROTTLE MAP, AS % | 30 |
| M3 THRTL MAP | MODE 3 THROTTLE MAP, AS % | 30 |
| M4 THRTL MAP | MODE 4 THROTTLE MAP, AS % | 30 |
| FIELD MIN | MIN. FIELD CURRENT, IN AMPS | 7 |
| FIELD MAX | MAX. FIELD CURRENT, IN AMPS | 30 |
| FIELD MAP START | Armature current at wich FIELD MAP takes effect, amps | 70 |
| FIELD MAP | Field Winding Current, as % of Armature Current | 50 |
| CURRENT RATIO | CURRENT RATIO:FACTOR OF 1, 2, 4 OR 8 | 1 |
| RESTRAINT | RAMP RESTRAINT: 1 TO 10 | 3 |
| LOAD COMP | LOAD COMPENSATION: 0 TO 25 | 0 |
| HPD | HIGH PEDAL DISABLE (HPD) TYPE | 1 |
| SRO | STATIC RETURN TO OFF (SRO) TYPE | 1 |
| SEQUENCING DLY | SEQUENCING DELAY, IN SEC. | 1 |
| MAIN CONT INTR | MAIN CONTACTOR INTERLOCK: ON OR OFF | ON |
| MAIN OPEN DELAY | MAIN CONTACTOR DROPOUT DELAY, IN SEC. | 1 |
| WELD CHECK | MAIN CONTACTOR WELD CHECK: ON OR OFF | ON |
| MAIN CHECK | MAIN COIL OPEN CHECK: ON OR OFF | ON |
| AUX ENABLE | AUXILIARY ENABLE: ON OR OFF | OFF |
| EM BRAKE | ELECTROMAGNETIC BRAKE ON OR OFF | OFF |
| AUX DELAY | AUXILIARY DRIVER DROPOUT DELAY, IN SEC. | 0 |
| AUX CHECK | AUXILIARY COIL OPEN CHECK: ON OR OFF | OFF |
| EM BRAKE DELAY | ELECTROMAGNETIC BRAKE DELAY, IN SEC. | 0 |
| EM BRAKE CHECK | ELECTROMAG. BRAKE OPEN CHECK: ON OR OFF | OFF |
| REV DRVR CHECK | REVERSE SIGNAL OPEN CHECK: ON OR OFF | OFF |
| CONT PULL IN | CONTACTOR COIL PULL-IN VOLTAGE, AS % | 100 |
| CONT HOLDING | CONTACTOR HOLDING VOLTAGE, AS % | 100 |
| EMR REV ENABLE | EMERGENCY REVERSE FUNCTION : ON OR OFF | OFF |
| EMR REV C/L | EMERGENCY REVERSE CURRENT LIMIT, IN AMPS | 50 |
| EMR REC CHECK | EMERGENCY REV. WIRING CHECK : ON OR OFF | OFF |
| ANTI-TIEDOWN | ANTI-TIEDOWN: ON OR OFF | OFF |
| FAULT CODE | ON OR OFF | ON |
| PEDAL INTERLOCK | THREADLE, PB-6, CHECK WIRING | OFF |
| PRECHARGE | ON OR OFF | ON |

# CURTIS PMC MOTOR CONTROLLER

# MANUAL

CURTIS PMC

# 1204X/1205X and 1209/1221

## MOTOR CONTROLLERS

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DESIGN OF CURTIS PMC 1200 SERIES CONTROLLERS PROTECTED BY U.S. PATENT NO. 4626750.

1204X / 1205X / 1209 / 1221 Manual
p/n 98796, Rev. D: May 1999

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# 1

# OVERVIEW

Curtis PMC Model 1204X/1205X and 1209/1221 electronic motor speed controllers are designed to provide smooth, silent, cost-effective control of motor speed and torque on a wide variety of industrial electric vehicles.

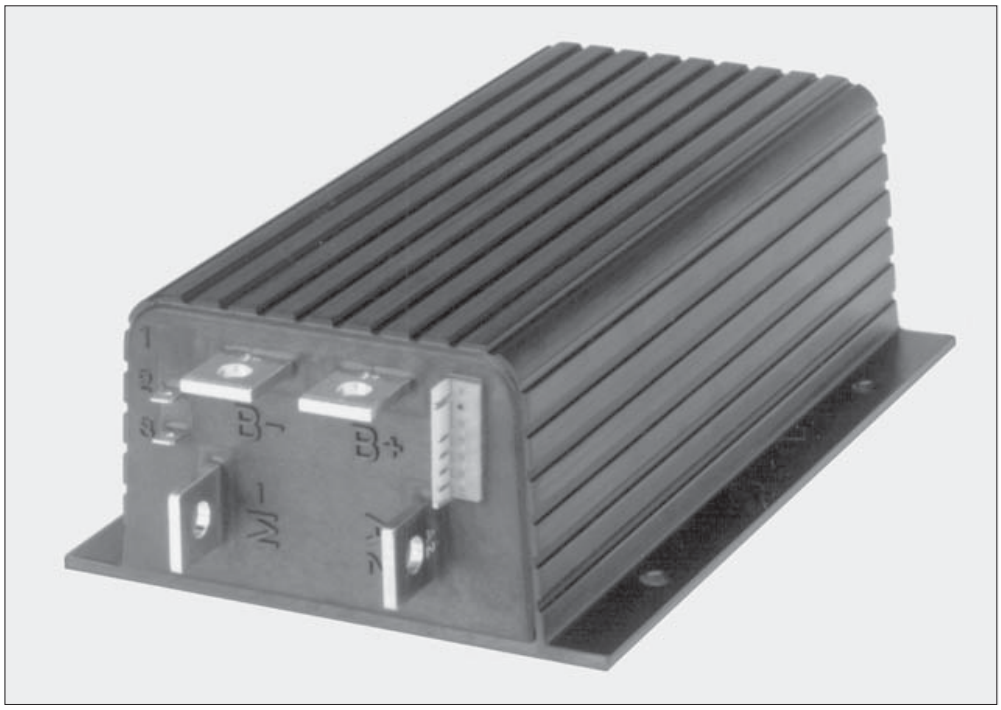


**Fig. 1** *Curtis PMC 1205X full-feature electronic motor controller.*

*Models 1204X, 1209, and 1221 have identical connections.*

Like all Curtis PMC 1200 series controllers, the 1204X/1205X and 1209/1221 models offer superior operator control of the vehicle's motor drive speed. Key features of these controllers include:

- ✓ Infinitely variable drive and brake control
- ✓ Power MOSFET design provides high efficiency (for reduced motor and battery losses) and silent operation
- ✓ High pedal disable (HPD) function monitors throttle status during turn-on and prevents operation until throttle has been returned to neutral *[optional feature]*
- ✓ Thermal protection and compensation circuit provides both under-temperature and overtemperature cutback, as well as steady current limit throughout the entire operating range
- ✓ Undervoltage cutback function protects against low battery voltage, including low voltage caused by external loads

*More Features* ☞

- ✓ Fault detection circuitry monitors battery, throttle connections, output transistors, bypass contactor, etc., to prevent runaway conditions
- ✓ Static return to off (SRO) function requires that forward or reverse selectors be returned to neutral before output is allowed *[optional feature]*
- ✓ Emergency reverse enhances plugging current when "belly-button" is activated on walkie-type applications *[optional feature]*
- ✓ Delayed bypass (1A) output drives a bypass contactor *[optional feature]*
- ✓ Forward, reverse, and bypass contactor driver outputs are internally protected against shorts in the contactor coils
- ✓ Simple installation with no adjustments required
- ✓ Tin-plated solid copper bus bars
- ✓ Push-on connectors for control wiring

Familiarity with your Curtis PMC controller will help you to install and operate it properly. We encourage you to read this manual carefully. If you have questions, please contact the Curtis office nearest you.

**CAUTION**

**Working on electric vehicles is potentially dangerous.** You should protect yourself against runaways, high current arcs, and outgassing from lead acid batteries:

**RUNAWAYS** — Some fault conditions could cause the vehicle to run out of control. Jack up the vehicle and get the drive wheels off the ground before attempting these procedures or any other work on the motor control circuitry.

**HIGH CURRENT ARCS** — Electric vehicle batteries can supply very high power, and arcs can occur if they are short circuited. Always open the battery circuit before working on the motor control circuit. Wear safety glasses, and use properly insulated tools to prevent shorts.

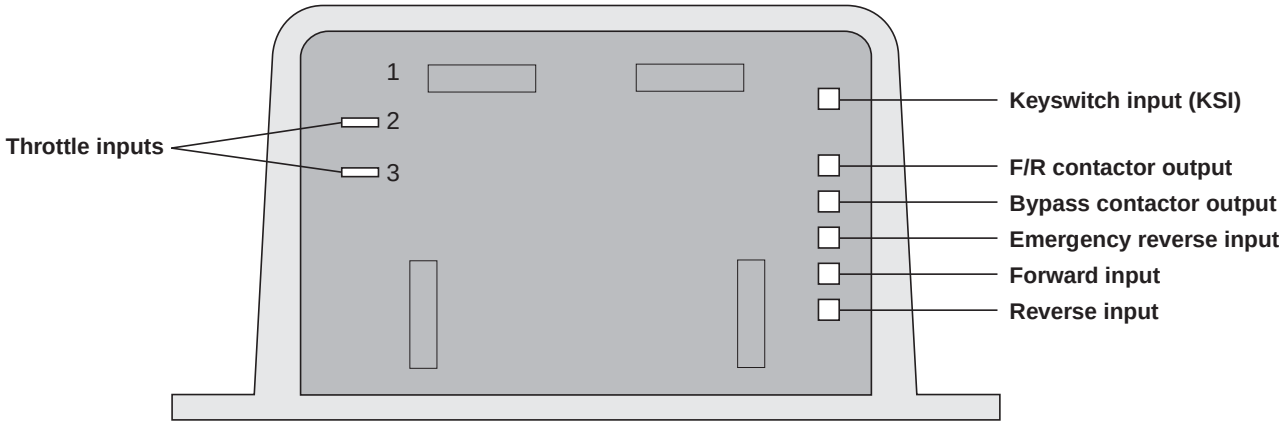
**LEAD ACID BATTERIES** — Charging or discharging generates hydrogen gas, which can build up in and around the batteries. Follow the battery manufacturer's safety recommendations. Wear safety glasses.

# 3 WIRING

## CONNECTIONS: Low Current

Two 1/4" push-on terminals are provided for the throttle inputs. If your controller has a voltage throttle input, there will be only one throttle terminal.

A 6-pin low power connector molded into the right side of the controller face provides the low power logic control connections—KSI input, forward/reverse contactor output, bypass contactor output *(optional)*, emergency reverse *(optional)*, and forward and reverse inputs.

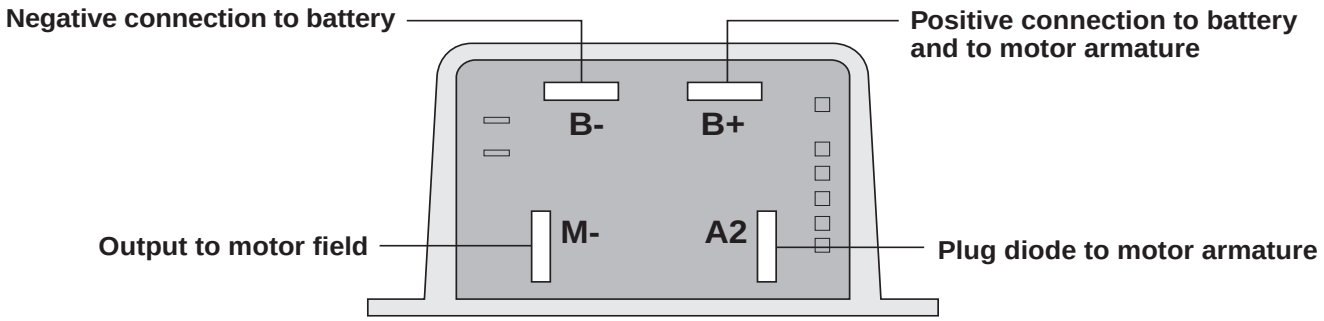



Several manufacturers make mating connectors that fit this connector. The part numbers listed are for the recommended 0.75 mm² (#18 AWG) vinyl insulated stranded wire.

| MFR | PART NUMBER | DESCRIPTION |
|---|---|---|
| AMP | #640426-7 | locking, insulation displacement terminals, wires at right angle to connector |
| Methode | #3300-107-218 | locking, insulation displacement terminals |
| Molex | #09-50-3071 | locking, crimp terminals |
| Panduit | #CE156F18-7 | locking, insulation displacement terminals, wires at right angle to connector |

## CONNECTIONS: High Current

Four tin-plated solid copper bus bars are provided for the high current connections to the battery and motor.




The cables used for the battery and motor connections must be heavy enough to carry the high current required. Rubber insulated welding cable is convenient to work with because of its flexibility.

Connections to the controller bus bars should be made with lugs suitable for the cable used, fastened by M8 (5/16") bolts and nuts. **When tightening the bolts, two opposing wrenches should be used.** Failure to use the double-wrench technique could cause undue strain to be placed on the internal connections, and could also result in cracked seals around the bus bars.

## WIRING: TYPICAL INSTALLATION

Curtis PMC 1204X/1205X/1209/1221 controllers are designed to satisfy the requirements of material handling applications using series motors. Figure 8 is a schematic diagram of the installation shown in Figure 7. Wired this way, the vehicle will plug brake if the direction is changed with the vehicle moving and the throttle applied. Reversing is accomplished via a forward/reverse changeover contactor or two single-pole, double-throw (2×SPDT) contactors. Coil suppression diodes should be used on the main and forward/reverse contactors.

### KSI Wiring

The keyswitch input (KSI) circuit includes inputs from the keyswitch and from the various interlocks. The controller KSI is used to turn the controller on and off. KSI is turned on by connecting it to battery B+. Any positive voltage greater than about 8 volts will turn on the controller, but usually the full vehicle battery voltage is used.

In its simplest form, KSI is operated by a keyswitch that turns the vehicle off and prevents unauthorized use. The keyswitch should also turn off the main

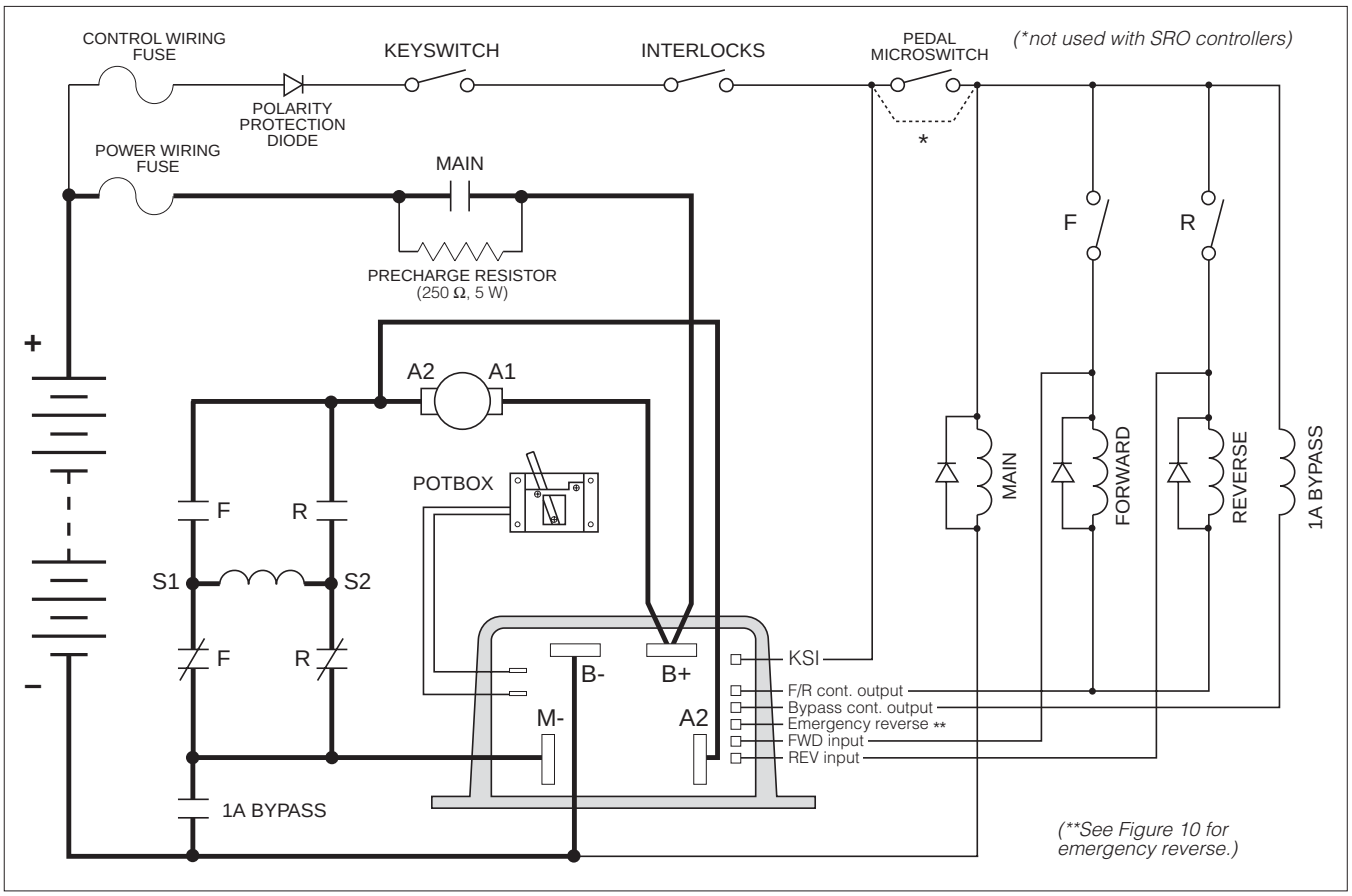



**Fig. 8** *Basic wiring configuration, Curtis PMC 1204X/1205X/1209/1221 controllers.*

contactor and the forward/reverse contactors. This will act as a safety feature by removing power from the motor control system when the keyswitch is off.

Interlocks (seat switches, battery charger interlocks, etc.) should be wired in series so that they turn off the controller KSI and the contactors. An SRO interlock (a seat switch, for example) **must** be wired in order to implement the optional SRO feature.

### Forward/Reverse Wiring

The forward/reverse wiring schemes described here all assume the power wiring shown by the heavy lines in Figure 8. Some vehicles, especially those previously using older, resistor-type controllers, may reverse the motor armature rather than the field winding. Be careful if you are replacing this type of controller. **When using the Curtis PMC controller it is essential that the field be reversed and that the armature be connected directly to the controller's B+ and A2 terminals, because the plug diode inside is connected to these terminals.**

# 4 MAINTENANCE & ADJUSTMENT

Curtis PMC 1204X/1205X/1209/1221 controllers and potboxes require only minimal maintenance if properly installed. NOTE: The controllers are sealed and thus are not field serviceable.

## CONTROLLER

### Maintenance

CAUTION

It is recommended that the following two steps be performed occasionally. **First remove power by disconnecting the battery, and discharge the capacitors in the controller** (with a light bulb or a 2–10 Ω, 25 W resistor connected for a few seconds across B+, B-). Follow good safety practices: get the vehicle drive wheels off the ground, wear safety glasses, and use insulated tools *(see page 2).*

1. Make sure the electrical connections to the controller (and to the motor, contactors, etc.) are tight. When checking the controller bus bar connections for tightness, use two opposing wrenches. This double-wrench technique will help avoid putting stress on the bus bars, which could crack the seals. **Always use insulated wrenches.**

2. Inspect all seals at the front and back of the controller. If necessary, use a moist rag to wipe these areas clean enough so that you can see the seals. Look for cracks and other signs of seal damage.

   If the seals are intact, clean the controller thoroughly either by washing it off or by wiping it clean with a moist rag. **Power must not be reapplied until the controller terminal area is completely dry.**

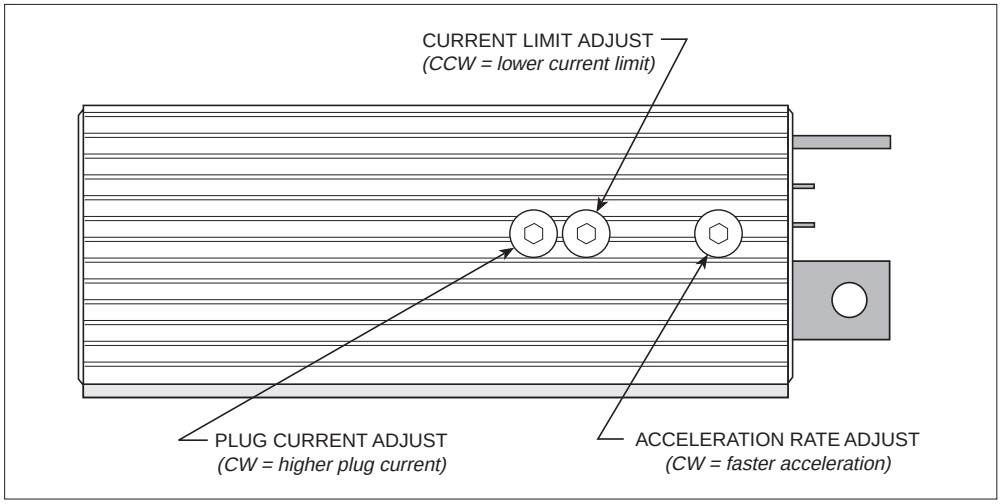
   If the seals have been damaged, there are several possible causes. Perhaps the double-wrench technique was not used when the cables were installed. Perhaps the vehicle's environment requires that the controller be better protected: either by mounting it in a different location, or by installing a protective cover.

   **Damaged seals can lead to faulty operation.** We strongly recommend replacing controllers that have faulty seals.

### Adjustment

Some controllers allow adjustment of the plug braking current, current limit, and acceleration rate settings. The adjustment pots on these models are located as shown in Figure 16.

**Fig. 16** *Adjustment pots.*




Use the following adjustment procedure. **The keyswitch should be <u>off</u> during adjustment.**

1. Remove the socket head screw (1/8" Allen) for the adjustment you want to make.

2. Adjust the internal potentiometer using a small **insulated** screwdriver *(available from Curtis).*

3. Replace the socket head screw and nylon seal washer. To prevent stripping, do not over-tighten.

## POTBOX

### Maintenance

Potbox maintenance is similar to controller maintenance: inspect for integrity of connections and mounting, and clean (with a moist rag) as required.

### Adjustment

Curtis PMC potboxes are factory set and rarely require user attention. To test and adjust, connect an ohmmeter to the potbox wires and use this procedure:

1. With the spring holding the lever arm against the return stop, the resistance should be less than 50 ohms. Slowly move the lever. If the resistance abruptly starts to increase when the lever is 3 mm (1/8") from the stop (1.5 mm [1/16"] for potboxes without the microswitch), no adjustment is needed.

2. If adjustment is required, loosen the screw holding the lever on the pot shaft. Use a screwdriver to rotate the pot shaft slightly with respect to the lever. Recheck the point at which the resistance starts to increase and continue making adjustments until the increase starts at 3 mm (1/8") [at 1.5 mm (1/16") for potboxes without the microswitch]. When adjustment is correct, tighten the screw holding the lever on the pot shaft, then recheck to see that this action did not disturb the adjustment. Make sure that the lever is still seated down on the pot shaft below the slight bevel on the end of the shaft.

3. Check the resistance with the lever pushed all the way to the other stop. It should be between 4500 and 5500 ohms. If it is outside this range, the potbox is faulty and should be replaced.

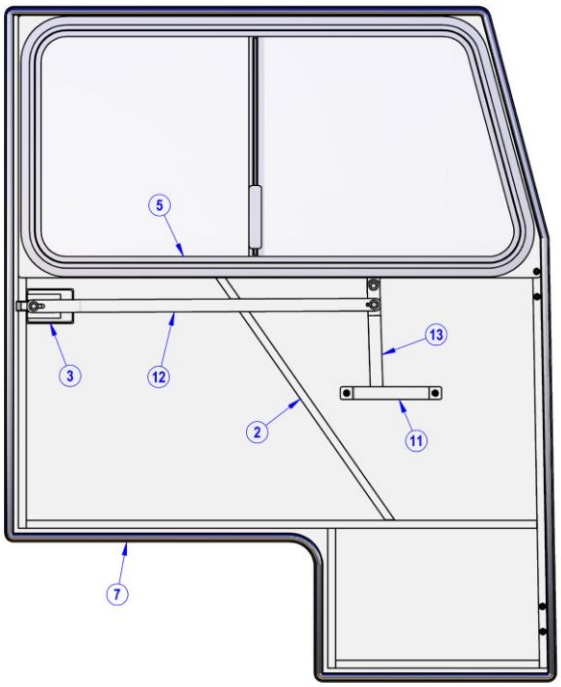
4. For potboxes equipped with a microswitch, check for correct switch operation. Use an ohmmeter, or simply listen for the slight click the switch makes. It should operate when the lever is 1.5 mm (1/16") from the return stop. If it does not, adjust by loosening the two screws holding the slotted microswitch mounting plate to the stop spacers and moving the plate. Recheck the switch operating point after tightening the screws.

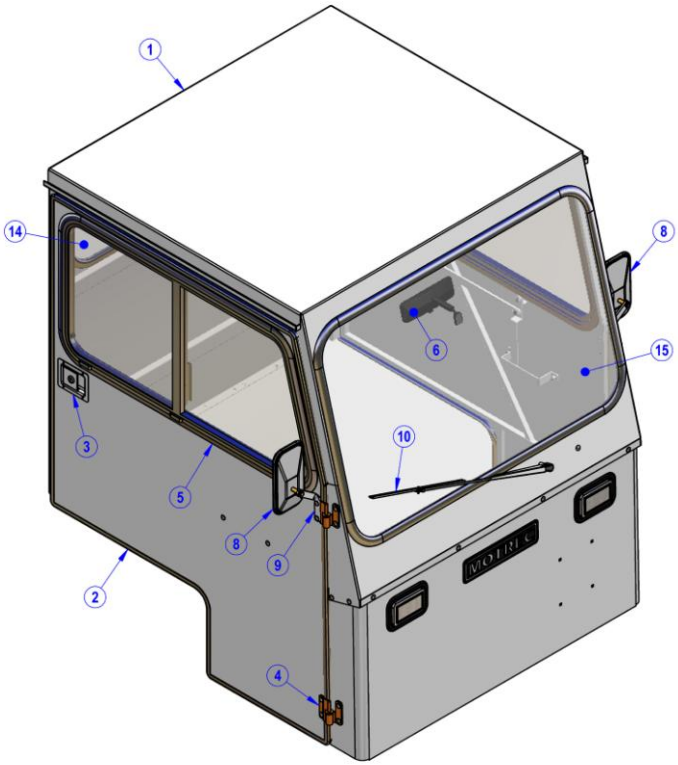
# SPARE PARTS

# BODY

| *RÉF.* | *NO. PIÈCE* | *DESCRIPTION* |
|---|---|---|
| 1 | 1005003 | SIÈGE BAQUET AVEC GLISSIÈRE |
| 2 | 120003 | GARNITURE |
| 3 | 2223360001 | 500X8 SOFTY WHEEL ASS |
| | 300022 | 5.7X8 L.R.D. WHEEL ASS |
| | 2207004 | MOLD-ON GREY RUBBER WHEEL |
| | 2223480001 | 6.9 X 9, 12PL TUFF GUARD |
| 4 | CONTACTER MANUF. | COUVERCLE DE PLATE-FORME |
| | CONTACTER MANUF. | COUVERCLE DE PL-FORME (TANDEM) |
| 5 | 2311000006 | PARE-CHOC AVANT & ARRIÈRE |

# CAB

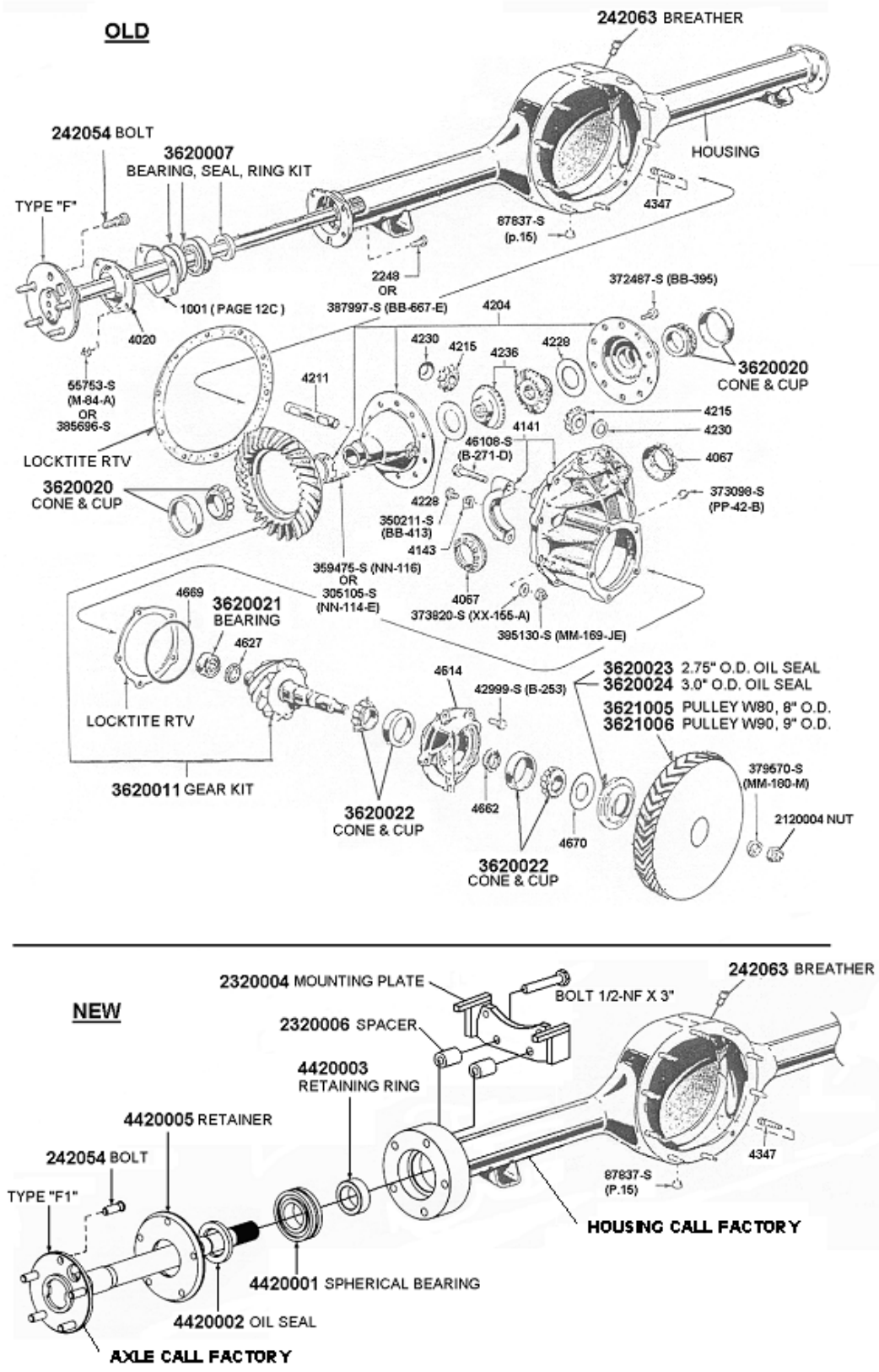



| *REF* | *PART NO* | *DESCRIPTION* |
|---|---|---|
| **1** | 2360660006 | STEEL CAB |
| | 2382320009 | SEATBACK CAB |
| **2** | 2360660007 | RIGHT DOOR |
| | 2360660008 | LEFT DOOR |
| **3** | 2803000003 | PADDLE LATCH |
| | 2366320015 | DOOR LATCH |
| **4** | 2365000001 | RIGHT HINGES KIT |
| | 2365000002 | LEFT HINGES KIT |
| **5** | 2367660002 | RIGHT DOOR GLASS |
| | 2367660001 | LEFT DOOR GLASS |
| **6** | 2801000002 | REAR VIEW MIRROR |
| **7** | 2802000001 | TRIM DOOR |

| *REF* | *PART NO* | *DESCRIPTION* |
|---|---|---|
| **8** | 2801000001 | SIDE MIRROR |
| **9** | 2399000014 | SIDE MIRROR BRACKET |
| **10** | 3113000001 | WIPER MOTOR |
| | 2800000002 | WIPER |
| | 2800000001 | ARM |
| **11** | 2366320001 | DOOR HANDLE |
| **12** | 2366660001 | DOOR HANDLE BAR |
| **13** | 2366320003 | DOOR LEVER |
| **14** | 2367300001 | REAR GLASS |
| **15** | 2367300002 | WINDSHIELD |

# FORD F-150 DIFFERENTIAL



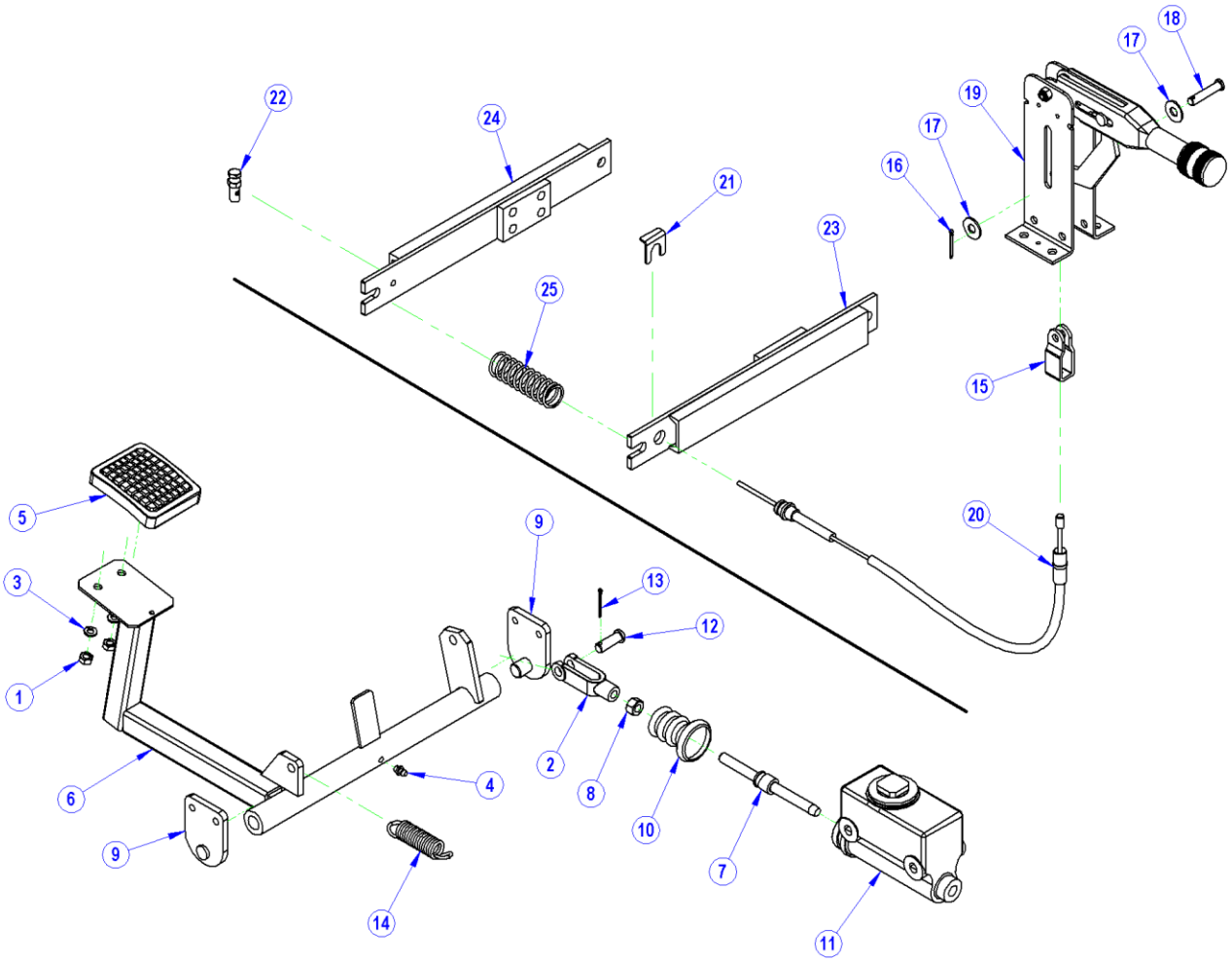
FORD WEC (NON-LOCKING) REAR AXLE SERVICE PARTS

| QTY. | PART NUMBER | | DESCRIPTION |
|---|---|---|---|
| 1 | 373098-S100 (PP-42-B) | | Plug (housing)-1/2"-14 |
| 1 | E3AZ | 4033-A | Cover assy. (housing)-also serviced in assy.-group 4010 |
| | | 4036 | Gasket (cover to housing)-use D6AZ 19562-B |
| | | 4067 | Shim (differential bearing adjustment) |
| AR | D9AZ | 4067-A | .241" thick |
| AR | D9AZ | 4067-B | .243" thick |
| AR | D9AZ | 4067-C | .245" thick |
| AR | D9AZ | 4067-D | .247" thick |
| AR | D9AZ | 4067-E | .249" thick |
| AR | D9AZ | 4067-F | .251" thick |
| AR | D9AZ | 4067-G | .253" thick |
| AR | D9AZ | 4067-H | .255" thick |
| AR | D9AZ | 4067-J | .257" thick |
| AR | D9AZ | 4067-K | .259" thick |
| AR | D9AZ | 4067-L | .261" thick |
| AR | D9AZ | 4067-M | .263" thick |
| AR | D9AZ | 4067-N | .265" thick |
| AR | D9AZ | 4067-P | .267" thick |
| AR | D9AZ | 4067-R | .269" thick |
| AR | D9AZ | 4067-S | .271" thick |
| AR | D9AZ | 4067-T | .273" thick |
| AR | D9AZ | 4067-U | .275" thick |
| AR | D9AZ | 4067-V | .277" thick |
| AR | D9AZ | 4067-W | .279" thick |
| AR | D9AZ | 4067-X | .281" thick |
| AR | D9AZ | 4067-Y | .283" thick |
| AR | D9AZ | 4067-Z | .285" thick |
| AR | D9AZ | 4067-AA | .287" thick |
| AR | D9AZ | 4067-AB | .289" thick |
| AR | D9AZ | 4067-AC | .291" thick |
| AR | D9AZ | 4067-AD | .293" thick |
| AR | D9AZ | 4067-AE | .295" thick |
| AR | D9AZ | 4067-AF | .297" thick |
| AR | D9AZ | 4067-AG | .299" thick |
| AR | D9AZ | 4067-AH | .301" thick |
| AR | D9AZ | 4067-AJ | .303" thick |
| AR | D9AZ | 4067-AK | .305" thick |
| AR | D9AZ | 4067-AL | .307" thick |
| | | 4200 | Differential assy.-refer to group in Section 40 |
| | | 4204 | Case assy. (differential) |
| 1 | E7TZ | 4204-E | Use with axle #720C,724S,730D-1987/ |
| 1 | E7TZ | 4211-A | Shaft (differential pinion kit)-use with axle #720C,724S,730D-1987/ Consists of 1-E7TW 4211-AA Shaft 1-D8BZ 4241-A Pin |
| 1 | E7TZ | 4215-A | Pinion kit-use with axle #720C,724S, 730D-1987/ Consists of 2-E7TW 4215-AA Pinion 2-E7TZ 4230-A Washer |
| 10 | D5AZ | 4216-A | Bolt (differential case)-self-locking-7/16"-20 x 3/4" |
| 2 | B7A | 4221-B | Cone and roller (differential bearing)-#LM603049 |
| 2 | D9AZ | 4222-A | Cup (differential bearing)-#LM603012 |
| | | 4228 | Washer (differential side gear thrust)-also serviced in kit-group 4236 |
| 2 | E7TZ | 4228-A | Use with axle #720C,724S,730D-1987/ |
| | | 4230 | Washer (differential pinion thrust)-also serviced in kit-group 4215 |
| 2 | E7TZ | 4230-A | Use with axle #720C,724S,730D-1987/ |

FORD WEC (NON-LOCKING) REAR AXLE SERVICE PARTS LIST NO. 237 — Cont'd

| QTY. | PART NUMBER | | DESCRIPTION |
|---|---|---|---|
| 1 | E7TZ | 4236-A | Gear kit (differential side)-use with axle #720C,724S,730D-1987/ Consists of 2-E7TZ 4228-A Washer 2-E7TW 4236-AA Gear |
| 2 | C7AZ | 4N237-A | "U" washer (axle shaft retaining) |
| 1 | D8BZ | 4241-A | Pin (differential pinion shaft lock) |
| 2 | C7AZ | 4A332-A | "O" ring (axle shaft) |
| | | 4346 | Bolt (housing cover)-self-locking-5/16"-18 x 5/8"-also serviced in assy.-group 4010 |
| 10 | E6TZ | 4346-A | Use with axle #WEC-A,B,720C,724S,730D,760B, 762T |
| 8 | E6TZ | 4346-A | Use with axle #760C,762P |
| 2 | E5TZ | 4346-A | Stud (housing cover)-5/16"-18 and-5/16"-18 x 1 1/2" long-also serviced in assy.-group 4010-use with axle #760C,762P |
| 1 | B7A | 4616-A | Cup (driving pinion bearing front)-#88048 |
| 1 | B7A | 4621-A | Cone and roller (drive pinion front bearing)-#M88048 |
| 1 | C7AZ | 4628-A | Cup (driving pinion bearing-rear)-#M802011 |
| 1 | C7AZ | 4630-A | Cone and roller (drive pinion rear bearing)-#M802048 |
| 1 | B7A | 4662-A | Spacer (driving pinion bearing)-1 5/16" I.D. x 15/32" long-collapsible-also serviced in kit-group 4209 |
| | | 4663 | Shim (pinion bearing)-serviced only in kit-group 4209 |
| 1 | D5AZ | 4670-A | Slinger (pinion shaft oil) |
| 1 | E5DZ | 4676-A | Seal assy. (drive pinion oil)-#E5DW 4676-AA |
| | | 4851 | Flange assy. (universal joint)-axle end |
| 1 | E7UZ | 4851-A | 1330 size-1987/ |
| 1 | 389546-S100 (MM-170-A) | | Locknut and washer assy. (flange to pinion)-3/4"-20-also serviced in kit-group 4209 |
| | | 4859 | Deflector (driving pinion oil seal) |
| 1 | E6TZ | 4859-A | Plastic-"From 1/86"-1986/ |

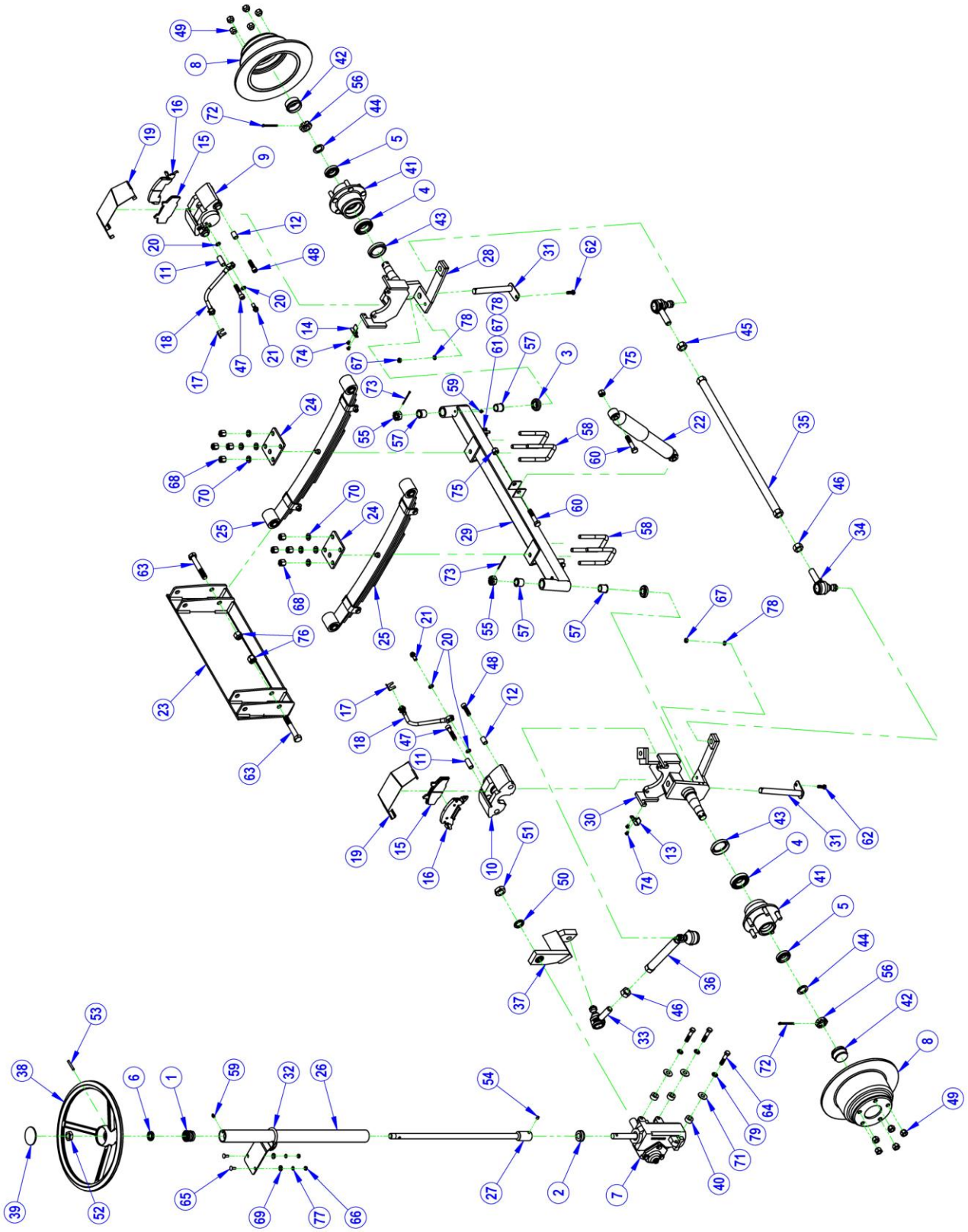
# BRAKE CONTROLS




| *REF* | *PART NO* | *DESCRIPTION* | *QTY* | *REF* | *PART NO* | *DESCRIPTION* | *QTY* |
|---|---|---|---|---|---|---|---|
| 1 | | Nut 1/4-20UNC | 1 | 14 | 2190000003 | Spring ( Extention ) | 1 |
| 2 | 2910000015 | Yoke | 1 | 15 | 2910000013 | Yoke | 1 |
| 3 | | Lock washer ¼ | 1 | 16 | | Cotter pin 3/32 x 1 | 1 |
| 4 | 2930000012 | Lubrication fitting | 1 | 17 | | Flat washer 5/16 | 2 |
| 5 | 2131100002 | Rubber pad | 1 | 18 | | Clevis pin 5/16 x 1-1/2 | 1 |
| 6 | 2131360002 | Lever | 1 | 19 | 2139240002 | Handbrake lever | 1 |
| *6* | 2131360012 | Lever | 1 | 20 | 2129000003 | Handbrake cable | 1 |
| 7 | 2133280001 | Push rod-Master cylinder | 1 | 21 | 2129000001 | Clip | 1 |
| 8 | | Nut 3/8-16UNF | 1 | 22 | 2921000001 | Cable stop | 1 |
| 9 | 2132320001 | Pivot | 2 | 23 | 2127000006 | Handbrake band (side cable) | 1 |
| 10 | | Boot, included with #2125000001 | 1 | 24 | 2127000001 | Handbrake band | 1 |
| 11 | 2125000001 | Master cylinder | 1 | 25 | 2191240002 | Spring ( compression ) | 1 |
| 12 | | Clevis pin 3/8 x 1-3/32 | 1 | | | | |
| 13 | | Cotter pin 3/32 x 1 | 1 | | | | |

* EE version

# FRONT ASSEMBLY

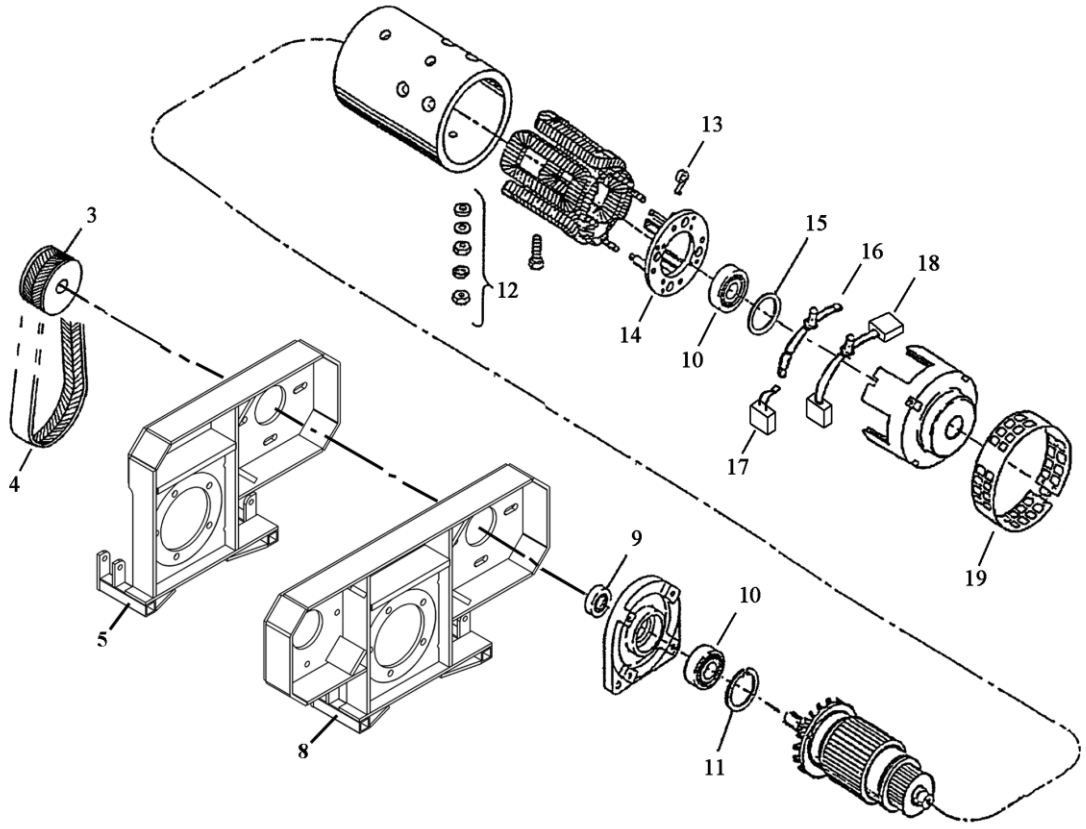


| *REF* | *PART NO* | *DESCRIPTION* |
|---|---|---|
| **1** | 2100300002 | BUSHING |
| | 2100300001 | BUSHING WITH OIL SEAL |
| **2** | 2100300003 | BUSHING |
| **3** | 2103250001 | THRUST BEARING |
| **4** | 2103300001 | TAPER BEAING |
| **5** | 2103300002 | TAPER BEAING |
| **6** | 2104300004 | OIL SEAL |
| **7** | 2117250001 | GEAR |
| **8** | 2120236001 | DISC |
| **9** | 481431 | RIGHT CALIPER |
| **10** | 481430 | LEFT CALIPER |
| **11** | 2121000005 | BUSHING, LONG |
| **12** | 2121000006 | BUSHING, SHORT |
| **13** | 2122300001 | LEFT CALIPER SUPPORT |
| **14** | 2122300002 | RIGHT CALIPER SUPPORT |
| **15** | 2128280001 | PADS |
| **16** | 2128280001 | PADS |
| **17** | 2129000001 | CLIP |
| **18** | 2134000001 | FLEX. HOXE |
| **19** | 2139000001 | CALIPER PROTECTOR |
| **20** | 2139000002 | WASHER |
| **21** | 2139000003 | BOLT |
| **22** | 2180240002 | SHOCK ABSORBER |
| **23** | 2182660002* | SHACKLE LINK |
| | 2182660005** | SHACKLE LINK |
| **24** | 2185660001 | PLATE |
| **25** | 2192606001 | LEAF SPRINGS |
| **26** | 2200300002 | TUBE |
| **27** | 2200300003 | SHAFT |
| **28** | 2201360002 | LEFT SPINDLE |
| **29** | 2201660001* | AXLE BEAM |
| | 2201660006** | AXLE BEAM |
| **30** | 2201660010 | RIGHT SPINDLE |
| **31** | 2205250001 | KING PIN |
| **32** | 2206300003 | STEERING SUPPORT, BOLT PATTERN 2 3/8” |
| | 2206320001 | STEERING SUPPORT, BOLT PATTERN 2 1/4” |
| **33** | 2207000001 | ROD END, LEFT HAND |
| **34** | 2207000002 | ROD END, RIGHT HAND |
| **35** | 2207660001* | REAR TIE ROD |
| | 2207660003** | REAR TIE ROD |
| **36** | 2207660005 | FRONT TIE ROD |
| **37** | 2207660011 | ARM |
| **38** | 2208240001 | STEERING WHEEL |
| **39** | 2208240002 | COVER |
| **40** | 2219250001 | SPACER |

| *REF* | *PART NO* | *DESCRIPTION* |
|---|---|---|
| **41** | 2224300002 | HUB |
| **42** | 2229300001 | DUST CAP |
| **43** | 2229300002 | OIL SEAL |
| **44** | 2229300003 | SPINDLE WASHER |
| **45** | 2910000005 | NUT, LEFT HAND |
| **46** | 2910000006 | NUT, RIGHT HAND |
| **47** | 2910000017 | BOLT, LONG |
| **48** | 2910000018 | BOLT,SHORT |
| **49** | 2910000019 | WHEEL NUT |
| **50** | 2910000020 | LOCK WASHER 7/8 |
| **51** | 2910000021 | JAM NUT 7/8-NF |
| **52** | 2910000022 | JAM NUT 3/4-NF |
| **53** | 2910000023 | SPRING PIN ¼ X 1 3/4 |
| **54** | 2910000024 | SET SCREW 5/16-NC |
| **55** | 2910300001 | CASTELLATED NUT 3/4-NF |
| **56** | 2910300002 | CASTELLATED NUT 1-UNEF |
| **57** | 2914364001 | BUSHING |
| **58** | 2916000001 | U-BOLT |
| **59** | 2930000012 | GREASE FITTING |
| **60** | | BOLT 1/2-NC X 2 1/2 |
| **61** | | BOLT 5/16-NC X 1 1/4 |
| **62** | | BOLT 5/16-NC X 1 |
| **63** | | BOLT 5/8-NC X 4 |
| **64** | | BOLT 7/16-NC X 2 |
| **65** | | CARRIAGE BOLT 1/4-NC X 3/4 |
| **66** | | NUT 1/4-NC |
| **67** | | NUT 5/16-NC |
| **68** | | HEAVY NUT 1/2-NF |
| **69** | | FLAT WASHER 1/4 |
| **70** | | FLAT WASHER 12mm |
| **71** | | FLAT WASHER 7/16 |
| **72** | | COTTER PIN 3/16 X 2 |
| **73** | | COTTER PIN 7/64 X 2 |
| **74** | | MACHINE SCREW 1/4-NC X 3/8 |
| **75** | | NYLON NUT 1/2-NC |
| **76** | | NYLON NUT 5/8-NC |
| **77** | | LOCK WASHER 1/4 |
| **78** | | LOCK WASHER 5/16 |
| **79** | | LOCK WASHER 7/16 |

* 54” Wide Frame
** 48” Wide Frame

# MOTOR AND DRIVE



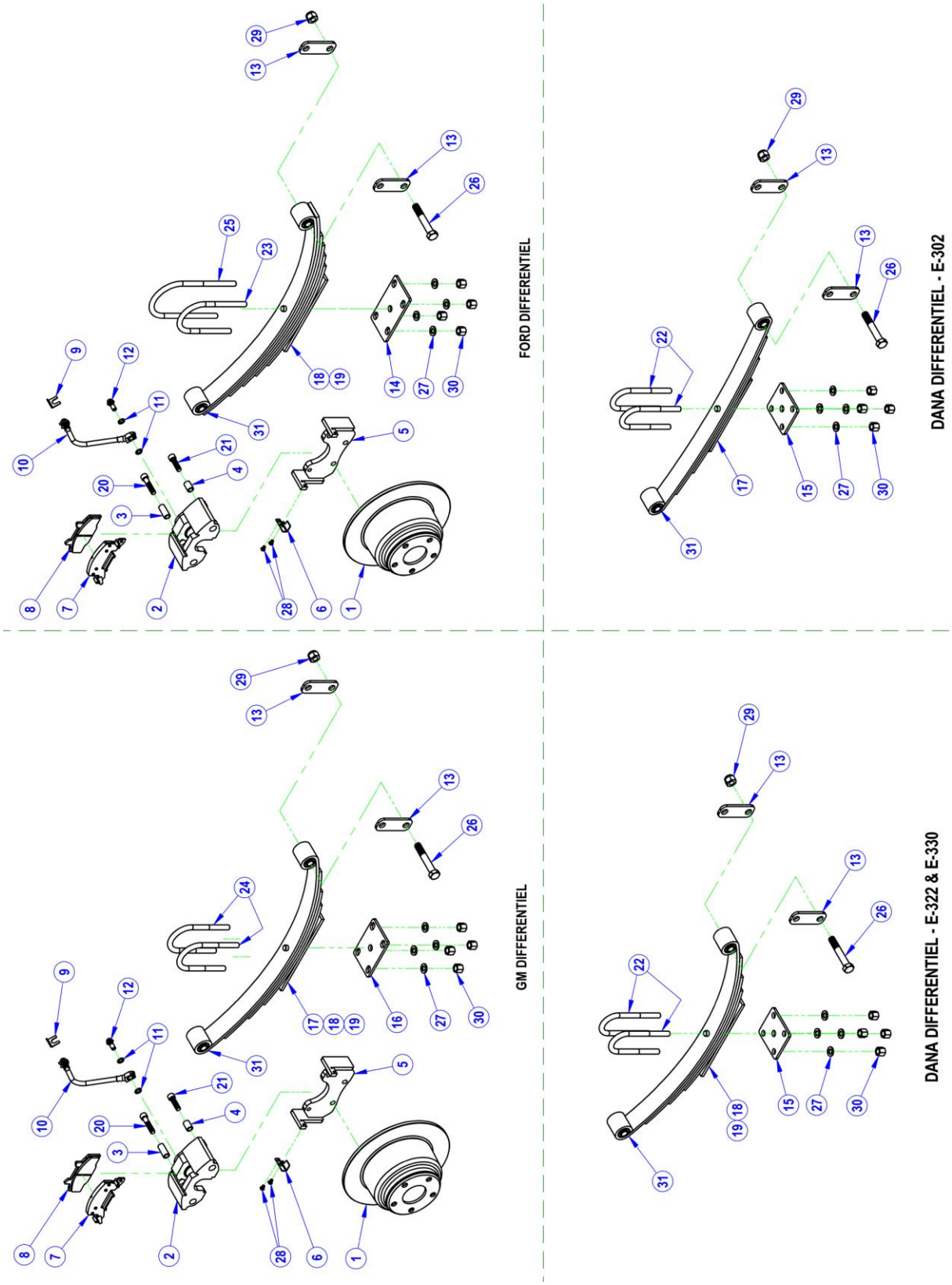

***COMMON PARTS***

| *REF* | *DESCRIPTION* | *PART #* | *REF* | *DESCRIPTION* | *PART #* |
|---|---|---|---|---|---|
| 3 | PULLEY ( 22 TEETH ) | 3651003 | 10 | BEARING | 484003 |
| | PULLEY ( 25 TEETH ) | 3651005 | 11 | SNAP RING | 484004 |
| 4 | BELT, EAGLE 1 MOTOR | 4851001 | 12 | NUT WASHER PACK | 484006 |
| | BELT, EAGLE 2 MOTOR | 6622006 | | | |
| 5 | MOTOR BASE, 1 MOTOR | 2154660001 | 15 | WAVY WASHER | 484013 |
| 8 | MOTOR BASE, 2 MOTOR | 2154660009 | 19 | HEADBAND | 484015 |
| | BELT TENSONER | 2152002 | | EE HEADBAND KIT | A91-107A |
| 9 | SEAL | 484001 | | | |

***SPECIFIC***

| REF | DESCRIPTION | *A89* | *B98* | *A00* | *D00 SEPEX* | *DC3 SEPEX* | *DANA DRIVE* |
|---|---|---|---|---|---|---|---|
| | MOTOR ASS'Y | 484000 | 204050 | 2950002 | 2450003 | 3112210001 | 3122230001 |
| 13 | BRUSH SPRING | 484010 | 484010 | 2450006 | 2450006 | 2450006 | 2450006 |
| 14 | BRUSH PLATE | 484011 | 484011 | 2450007 | 2450007 | 2450007 | 2450007 |
| 16 | LEAD ASSY. | 484017 | 484017 | N/A | N/A | N/A | N/A |
| 17 | BRUSH | 484009 | 484009 | N/A | N/A | N/A | N/A |
| 18 | LEAD AND BRUSH ASSY. | N/A | N/A | 2450008 | 2450008 | 3112210004 | 2450008 |

# REAR SUSPENSION AND BRAKE



| *REF* | *PART NO* | *DESCRIPTION* |
|---|---|---|
| **1** | 2120236001 | DISC |
| **2** | 481431 | RIGHT CALIPER |
| | 481430 | LEFT CALIPER |
| **3** | 2121000005 | BUSHING, LONG |
| **4** | 2121000006 | BUSHING, SHORT |
| **5** | 2122236001 | MOUNTING PLATE, CALIPER |
| **6** | 2122300001 | LEFT CALIPER SUPPORT |
| | 2122300002 | RIGHT CALIPER SUPPORT |
| **7** | 2128280001 | PADS |
| **8** | 2128280001 | PADS |
| **9** | 2129000001 | CLIPS |
| **10** | 2134000001 | FLEX. HOXE |
| **11** | 2139000002 | WASHER |
| **12** | 2139000003 | BOLT |
| **13** | 2182320002 | SHACKLE LINK |
| **14** | 2185280001 | FORD PLATE |
| **15** | 2185320001 | DANA PLATE |
| **16** | 2185320002 | GM PLATE |
| **17*** | 2192320001 | 4 - LEAF SPRINGS |
| **18**** | 2192320001 | 5 - LEAF SPRINGS |
| **19***** | 2192320001 | 7 - LEAF SPRINGS, HEAVY DUTY |
| **20** | 2910000017 | BOLT, LONG |
| **21** | 2910000018 | BOLT,SHORT |
| **22** | 2916000002 | U-BOLT 1/2-NF X 2” I.D. |
| **23** | 2916280002 | U-BOLT 1/2-NF X 3 1/4” I.D. |
| **24** | 2916320001 | U-BOLT 1/2-NF X 2 3/4” I.D. |
| **25** | 2916480001 | U-BOLT 1/2-NF X 4” I.D. |
| **26** | | BOLT 5/8-NC X 4 |
| **27** | | FLAT WASHER 12mm |
| **28** | | MACHINE SCREW 1/4-NC X 3/8 |
| **29** | | NYLON NUT 5/8-NC |
| **30** | | HEAVY NUT 1/2-NF |
| **31** | 2183240002 | BUSHING |

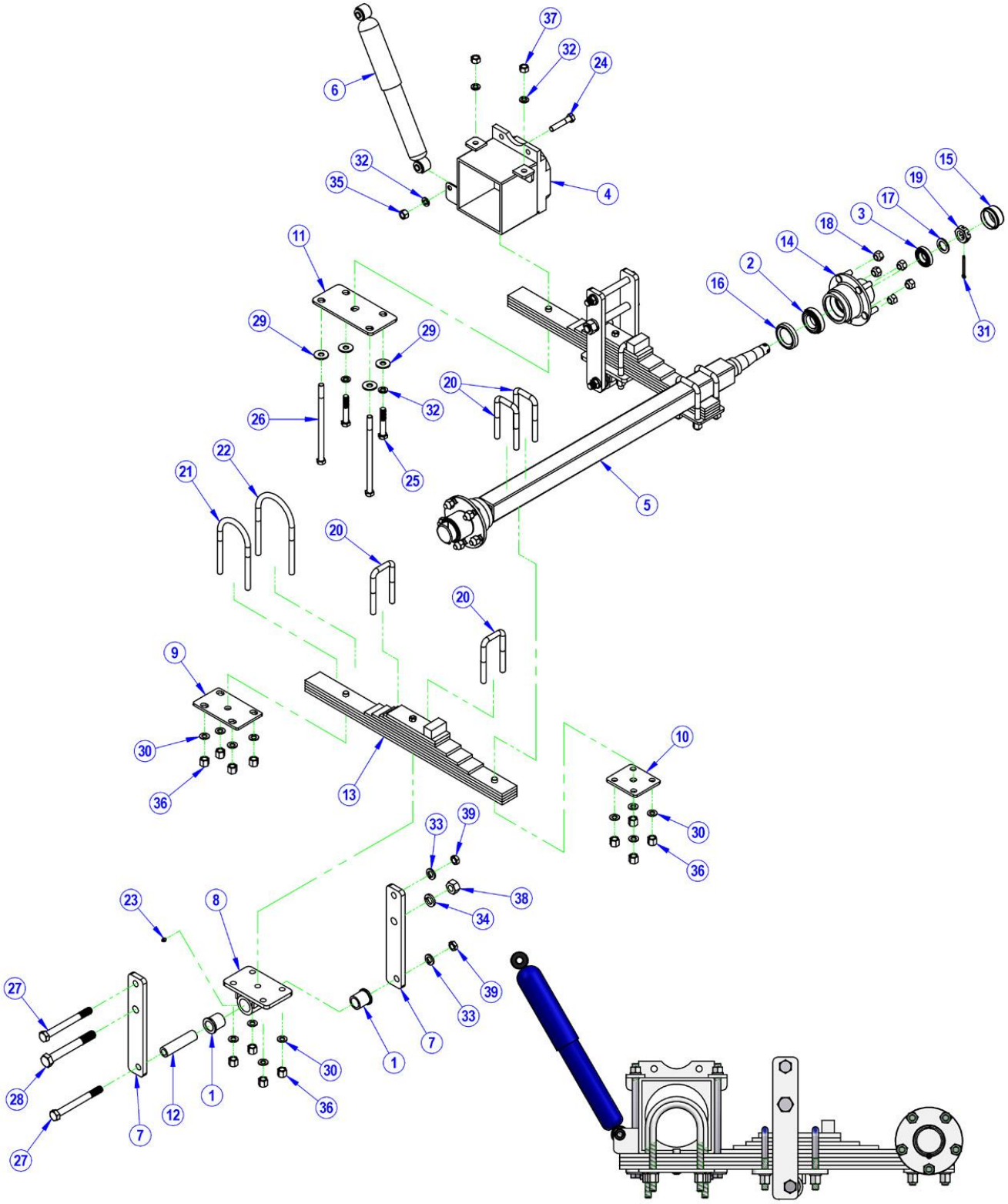
* E-302 & 348

** E-320, 322, 330, 360 & 480

*** STANDARD, E-500 & 660 AND OPTIONAL, E-320, 322, 330, 360 & 480

## REAR SUSPENSION (TAMDEM)

OPTIONAL

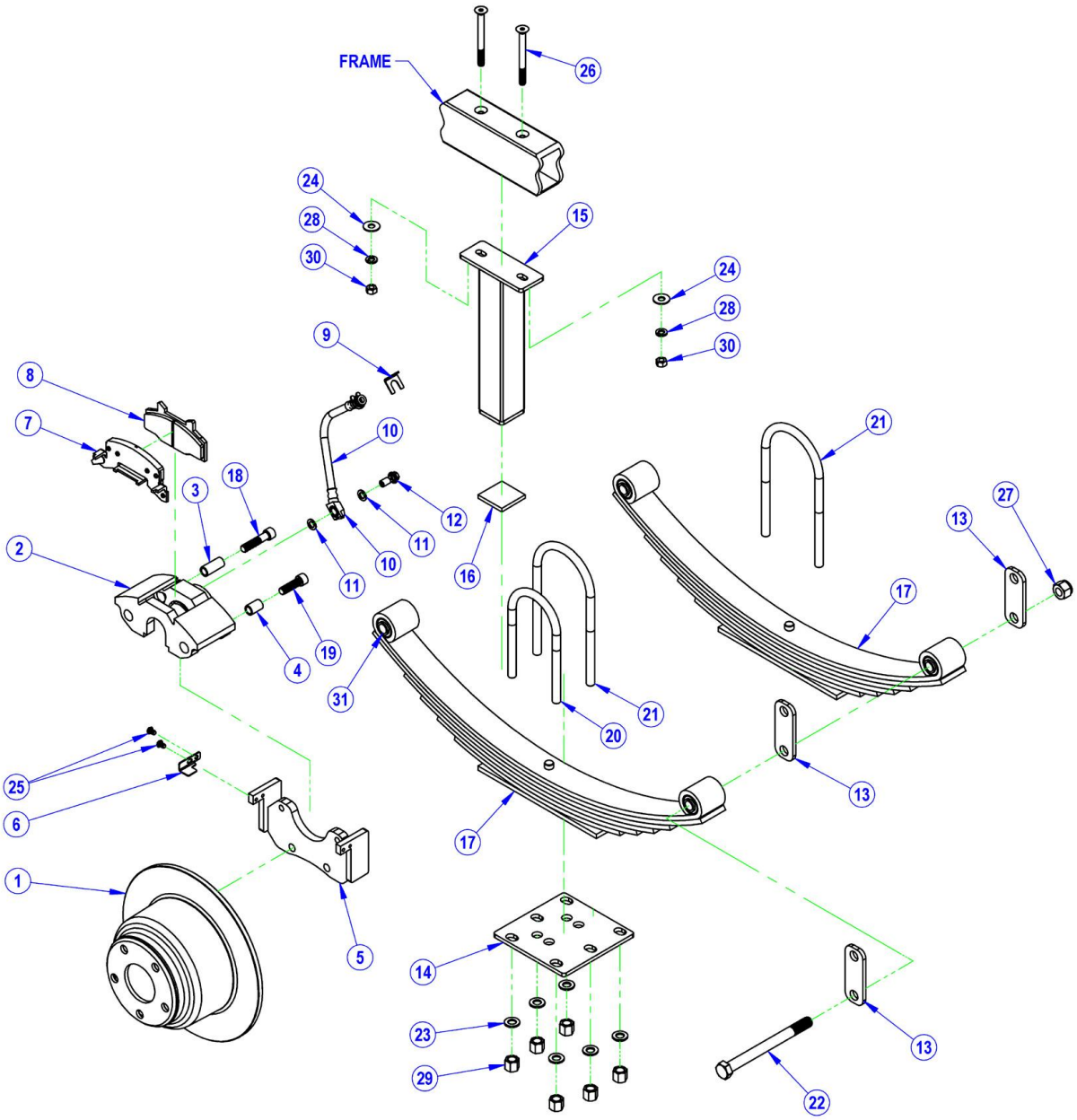


| *REF* | *PART NO* | *DESCRIPTION* |
|---|---|---|
| **1** | 2100300002 | BUSHING |
| **2** | 2103300001 | TAPER BEAING |
| **3** | 2103300002 | TAPER BEAING |
| **4** | CALL FACTORY | DIFFERENTIEL FORD |
| | *** 2177661001* | HYDRAULIC HOUSING |
| | *** 2177501001** | HYDRAULIC HOUSING |
| **5** | 2179660002* | REAR AXLE BEAM |
| | 2179660006** | REAR AXLE BEAM |
| **6** | 2180240002*** | SHOCK ABSORBER |
| **7** | 2182660009 | SHACKLE LINK |
| **8** | 2183660002 | PIVOT |
| **9** | 2185280001 | PLATE |
| **10** | 2185320001 | PLATE |
| **11** | 2185501001 | PLATE |
| **12** | 2189660002 | SHAFT |
| **13** | 2192660001 | LEAF SPRINGS |
| **14** | 2224300002 | HUB |
| **15** | 2229300001 | DUST CAP |
| **16** | 2229300002 | OIL SEAL |
| **17** | 2229300003 | SPINDLE WASHER |
| **18** | 2910000019 | WHEEL NUT |
| **19** | 2910300002 | CASTELLATED NUT 1-UNEF |
| **20** | 2916000001 | U-BOLT 1/2-NF X 2” |
| **21** | 2916280002 | U-BOLT 1/2-NF X 3 1/4” I.D. |
| **22** | 2916480002 | U-BOLT 1/2-NF X 4” I.D. |
| **23** | 2930000012 | GREASE FITTING |
| **24*** ** | | BOLT 1/2-NC X 2 1/2 |
| **25** | | BOLT 1/2-NF X 3 |
| **26** | | BOLT 1/2-NF X 9 |
| **27** | | BOLT 5/8-NC X 6, GRADE 8 |
| **28** | | BOLT 3/4-NC X 6, GRADE 8 |
| **29** | | FLAT WASHER ½ |
| **30** | | FLAT WASHER 12mm |
| **31** | | COTTER PIN 3/16 X 2 |
| **32*** ** | | LOCK WASHER 1/2 |
| **33** | | LOCK WASHER 5/8 |
| **34** | | LOCK WASHER 3/4 |
| **35*** ** | | NUT 1/2-NC |
| **36** | | HEAVY NUT 1/2-NF |
| **37*** ** | | NUT 1/2-NF |
| **38** | | NUT 3/4-NC |
| **39** | | NUT 3/8-NC |

* 54” Wide Frame
** 48” Wide Frame
*** I.C. Internal Combustion

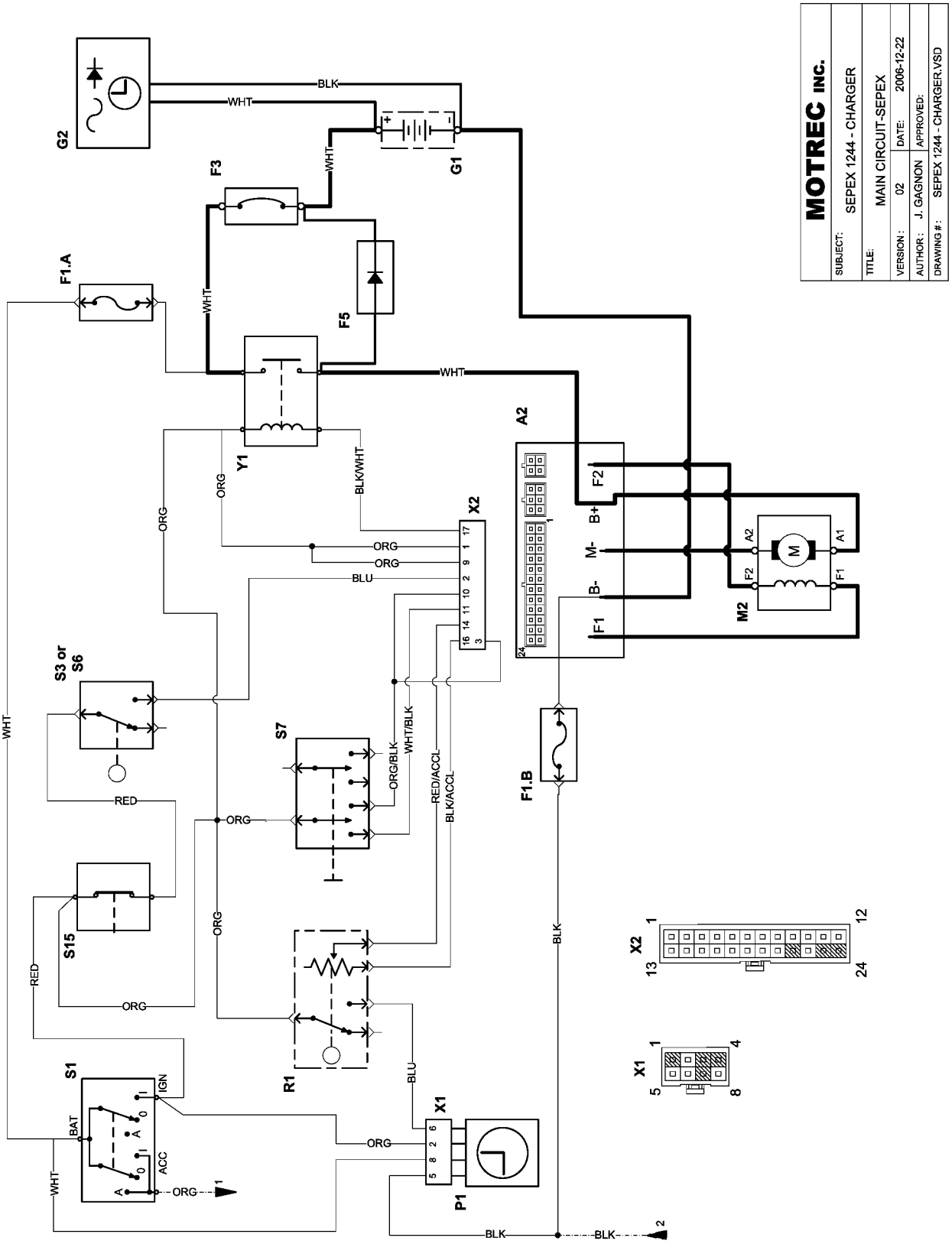
## REAR SUSPENSION (7000 LBS)

OPTIONAL

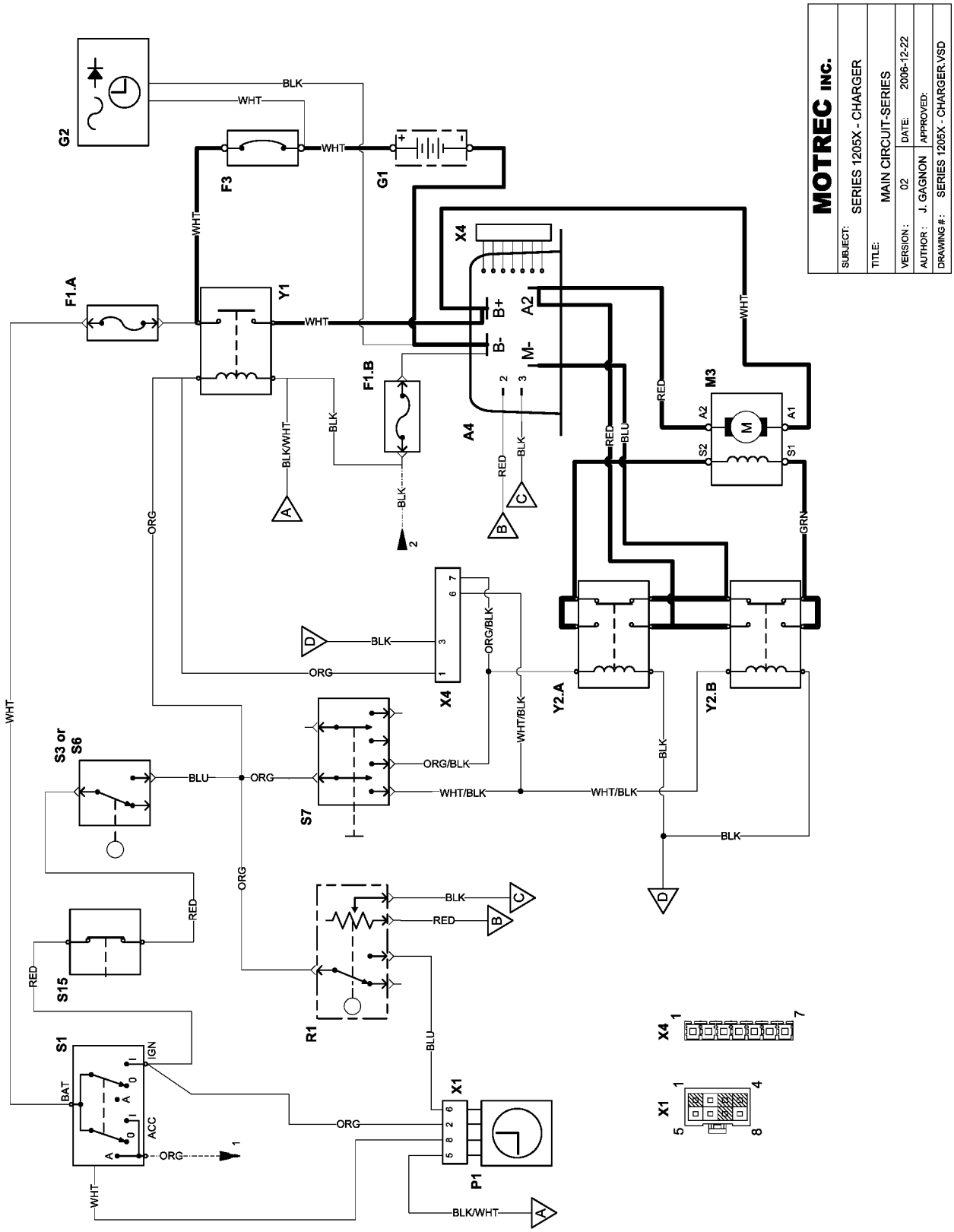


| *REF* | *PART NO* | *DESCRIPTION* |
|---|---|---|
| **1** | 2120236001 | DISC |
| **2** | 481431 | RIGHT CALIPER |
| | 481430 | LEFT CALIPER |
| **3** | 2121000005 | BUSHING, LONG |
| **4** | 2121000006 | BUSHING, SHORT |
| **5** | 2122236001 | MOUNTING PLATE, CALIPER |
| **6** | 2122300001 | LEFT CALIPER SUPPORT |
| | 2122300002 | RIGHT CALIPER SUPPORT |
| **7** | 2128280001 | PADS |
| **8** | 2128280001 | PADS |
| **9** | 2129000001 | CLIPS |
| **10** | 2134000001 | FLEX. HOXE |
| **11** | 2139000002 | WASHER |
| **12** | 2139000003 | BOLT |
| **13** | 2182320002 | SHACKLE LINK |
| **14** | 2185660002 | FORD PLATE |
| **15** | 2189660003 | LEAF SPRING STOPPER - KIT |
| | 2189660004 | LEAF SPRING STOPPER - UPPER PART |
| **16** | 2189660008 | LEAF SPRING STOPPER - RUBBER |
| **17** | 2192320002 | 7 - LEAF SPRINGS |
| **18** | 2910000017 | BOLT, LONG |
| **19** | 2910000018 | BOLT,SHORT |
| **20** | 2916280002 | U-BOLT 1/2-NF X 3 1/4” I.D. |
| **21** | 2916480001 | U-BOLT 1/2-NF X 4” I.D. |
| **22** | | BOLT 5/8-NC X 7, GRADE 8 |
| **23** | | FLAT WASHER 12mm |
| **24** | | FLAT WASHER 3/8 |
| **25** | | MACHINE SCREW 1/4-NC X 3/8 |
| **26** | | HEX SOCKET CAP SCREW, FLAT HEAD 3/8-NC X 4 |
| **27** | | NYLON NUT 5/8-NC |
| **28** | | LOCK WASHER 3/8 |
| **29** | | HEAVY NUT 1/2-NF |
| **30** | | NUT 3/8-NC |
| **31** | 2183240002 | BUSHING |

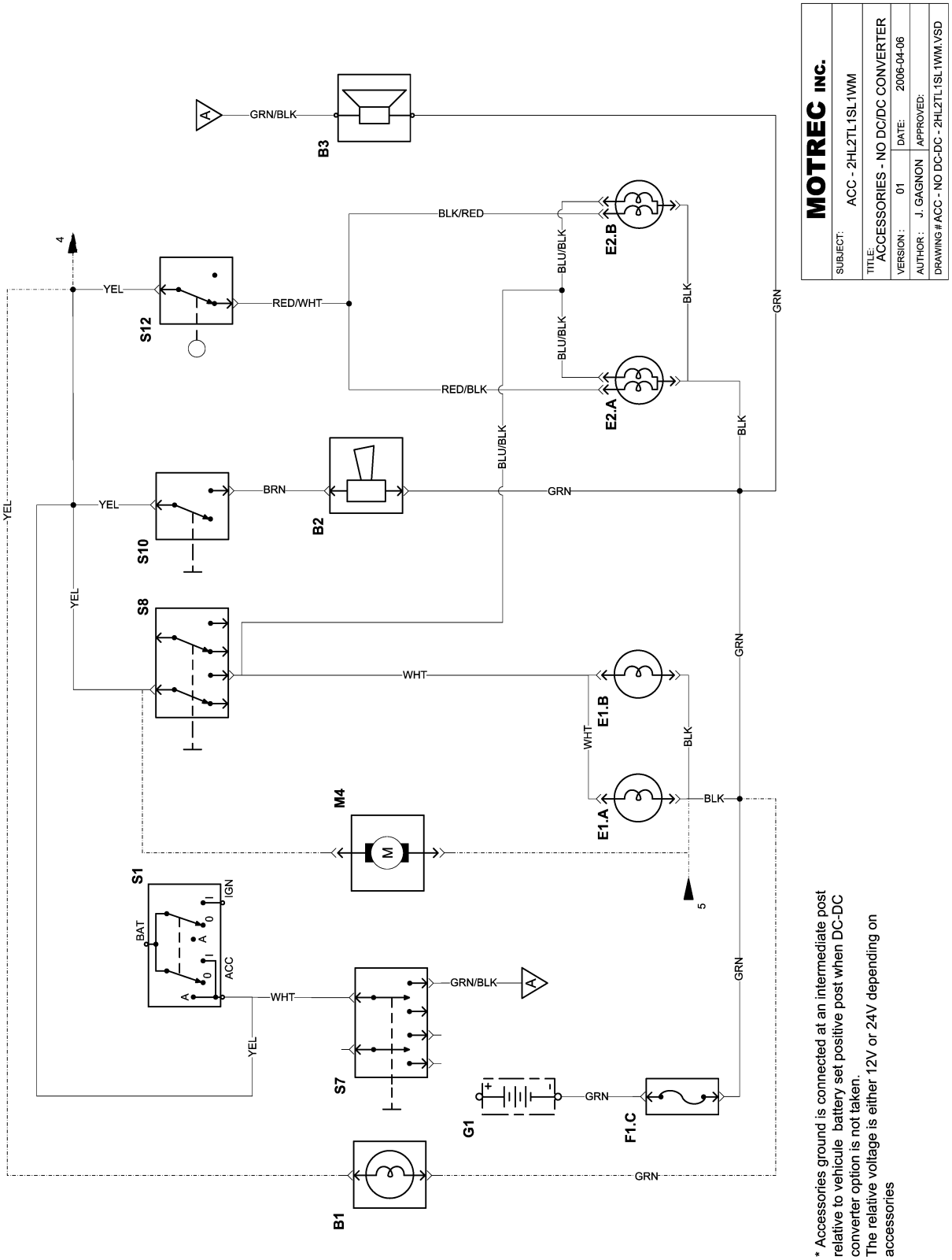
# ELECTRICAL DIAGRAM – SEPEX MAIN CIRCUIT
# DIAGRAMME ÉLECTRIQUE – CIRCUIT PRINCIPAL SEPEX



# ELECTRICAL DIAGRAM – SERIES MAIN CIRCUIT
# DIAGRAMME ÉLECTRIQUE – CIRCUIT PRINCIPAL SÉRIES

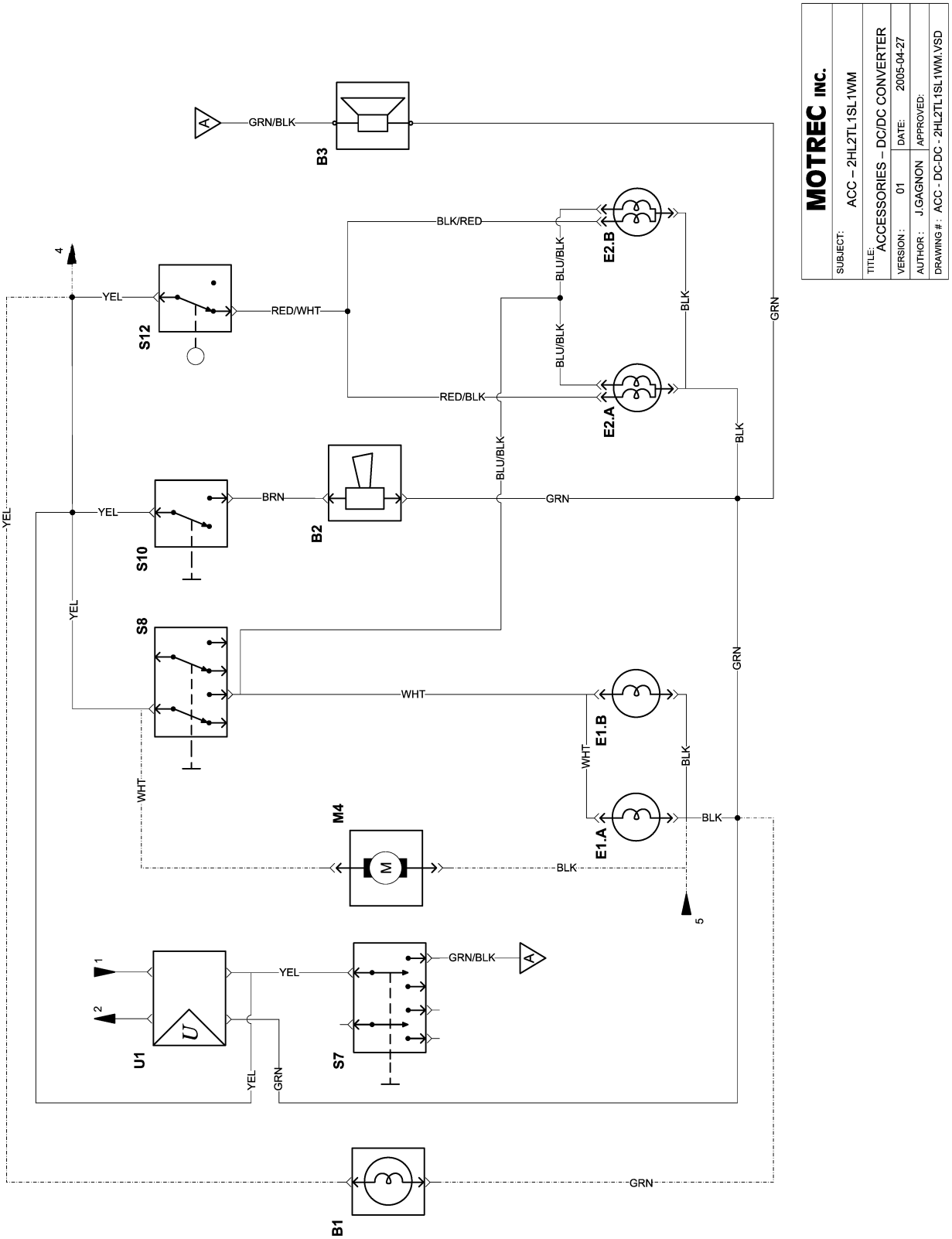


# ACCESSORIES – NO DC/DC CONVERTER
# ACCESSOIRES – SANS CONVERTISSEUR DC/DC

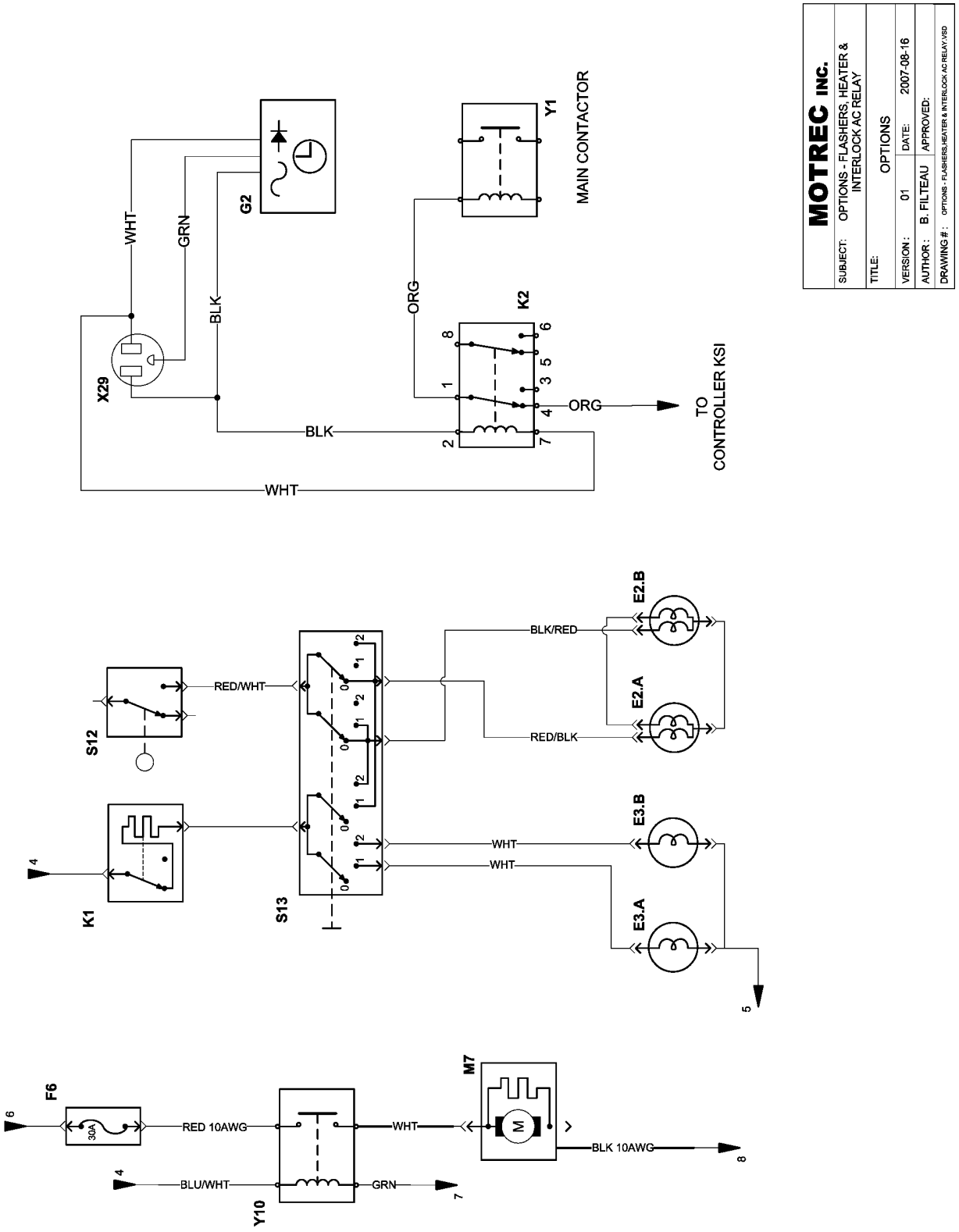



* Accessories ground is connected at an intermediate post relative to vehicule battery set positive post when DC-DC converter option is not taken.
The relative voltage is either 12V or 24V depending on accessories

# ACCESSORIES – DC-DC CONVERTER
# ACCESSOIRES – CONVERTISSEUR DC-DC



# OPTIONS


MOTREC INC.
SUBJECT: OPTIONS - FLASHERS, HEATER & INTERLOCK AC RELAY
TITLE: OPTIONS
VERSION: 01
DATE: 2007-08-16
AUTHOR: B. FILTEAU
APPROVED:
DRAWING # : OPTIONS - FLASHERS,HEATER & INTERLOCK AC RELAY.VSD
G2
WHT
GRN
BLK
X29
Y1
MAIN CONTACTOR
ORG
K2
TO CONTROLLER KSI
BLK
WHT
S12
RED/WHT
S13
K1
BLK/RED
RED/BLK
E2.B
E2.A
E3.B
E3.A
F6
30A
RED 10AWG
BLU/WHT
Y10
GRN
M7
BLK 10AWG

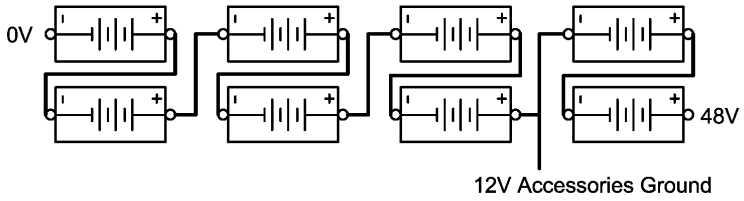
## PARTS LIST

| NO | DESIGNATION | REF | QTY |
|---|---|---|---|
| A2 | SEPEX SPEED CONTROL | 1244-5451 | 1 |
| A4 | SERIES SPEED CONTROL, 350A | 1205X-5301 | 1 |
| B1 | STROBELIGHT | * | 1 |
| B2 | HORN | * | 1 |
| B3 | REVERSE ALARM | * | 1 |
| E1.A,B | HEADLIGHT | * | 2 |
| E2.A,B | TAIL/BRAKE LIGHT | * | 2 |
| E3.A,B | AMBER FRONT LIGHT | * | 2 |
| F1.A,B,C | FUSE, 15A | 246108K | 3 |
| F3 | CIRCUIT BREAKER, 150A | 3107000002 | 1 |
| F5 | DIODE BRIDGE | 3669027 | 1 |
| G1 | BATTERY | | |
| G2 | BATTERY CHARGER | | 1 |
| K1 | FLASHER RELAY | 3069004 | 1 |
| K2 | 110 VAC RELAY | 366213 | 1 |
| | RELAY BASE | 246216 | 1 |
| | RELAY RETAINING CLIP | 246216C | 1 |
| M2 | SEPEX MOTOR | | 1 |
| M3 | SERIES MOTOR | | 1 |
| M4 | WIPER MOTOR | * | 1 |
| M7 | CAB HEATER | * | 1 |
| P1 | INDICATOR (BDI), HOUR METER | * | 1 |
| R1 | ACCELERATOR | 2142100001 | 1 |
| | MICROSWITCH | 367002 | 1 |
| | POTENTIOMETER | 367003 | 1 |
| | PLASTIC GEAR | 367015 | 1 |
| | SPRING | 2462008 | 1 |
| R4 | RESISTANCE, 250 OHMS | 367014 | 1 |
| S1 | KEY SWITCH | 246205 | 1 |
| S3 | SEAT SWITCH, MICRO-SWITCH | 3109100002 | 1 |
| S7 | FOWARD/REVERSE SELECTOR | 266211 | 1 |
| S8 | LIGHT SWITCH, ROCKER TYPE | 1269004 | 1 |
| | LIGHT SWITCH, PUSH/PULL | 486002 | 1 |
| S10 | HORN BUTTON | * | 1 |
| S12 | BRAKE LIGHT SWITCH | 246207 | 1 |
| | HYDRAULIC BRAKE LIGHT SWITCH | 3669004 | 1 |
| S13 | FLASHER SWITCH | * | 1 |
| S15 | EMERGENCY PUSH BUTTON | 3109800001 | 1 |
| | EMERGENCY PUSH BUTTON, LABEL | 3109800006 | 1 |
| U1 | DC-DC CONVERTER | * | 1 |
| X1 | HOUR METER CONNECTOR | | 1 |
| X2 | SPEED CONTROL CONNECTOR | | 1 |
| X4 | SPEED CONTROL CONNECTOR | | 1 |
| X5 | BATTERY CHARGER CONNECTOR | | 1 |
| X29 | PVC GROUNDING PLUG, YELLOW | 80003 | 1 |
| Y1 | 36 VOLT MAIN CONTACTOR | 3104236001 | 1 |
| | 48 VOLT MAIN CONTACTOR | 486222 | 1 |
| Y2.A,B | 36 VOLT F/R CONTACTOR | 366217 | 2 |
| | 48 VOLT F/R CONTACTOR | 486217 | 2 |
| Y10 | HEATER SOLENOID | 246101 | 1 |
| | F/R BUSSBARS | 2469003 | 1 |
| | STATIC STRAP | 2450001 | 1 |

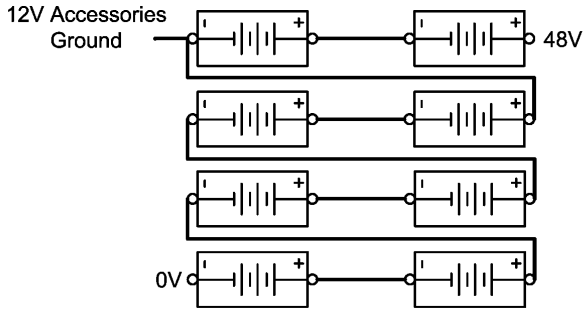
* Consult Motrec Illustrated parts

## BATTERY CONFIGURATIONS - 48V
## CONFIGURATIONS DES BATTERIES – 48V

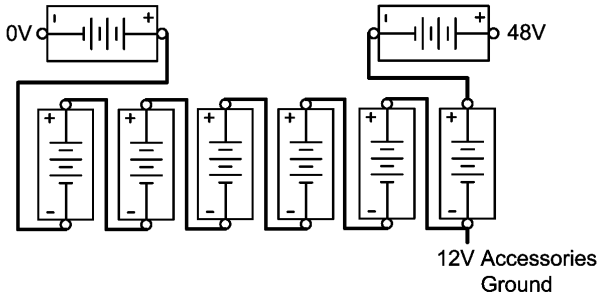
E-480
E-480TT
E-500



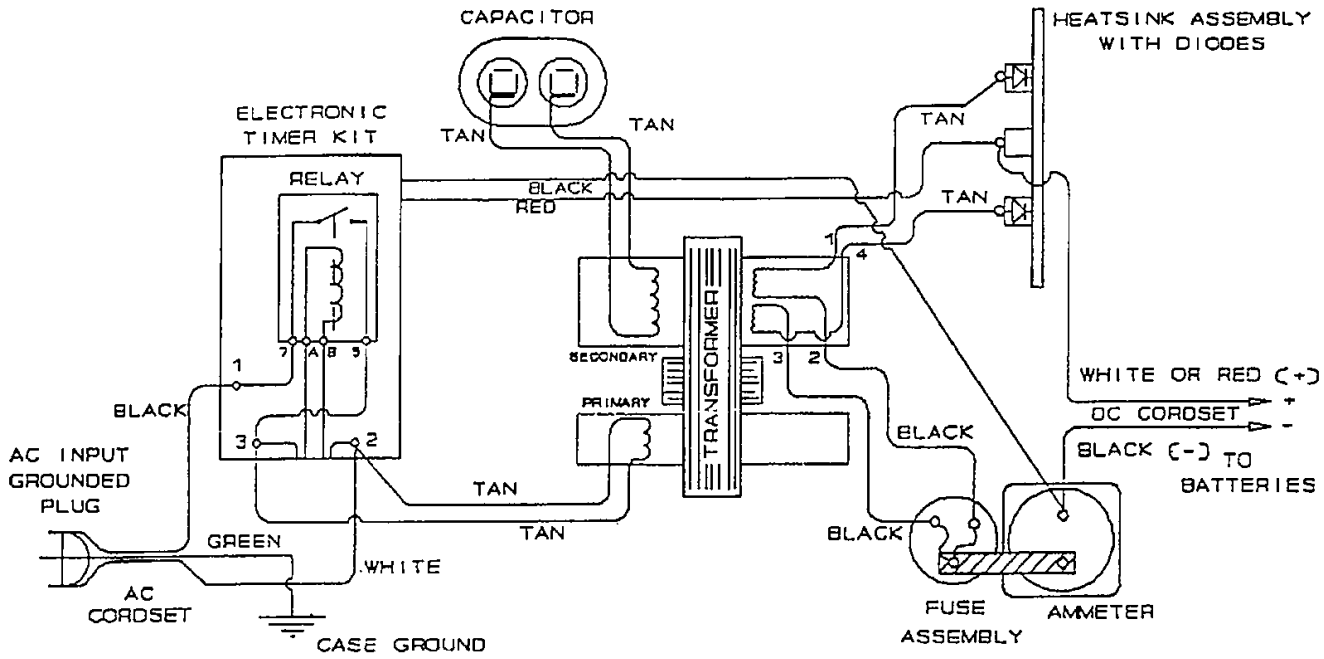

E-660




E-348



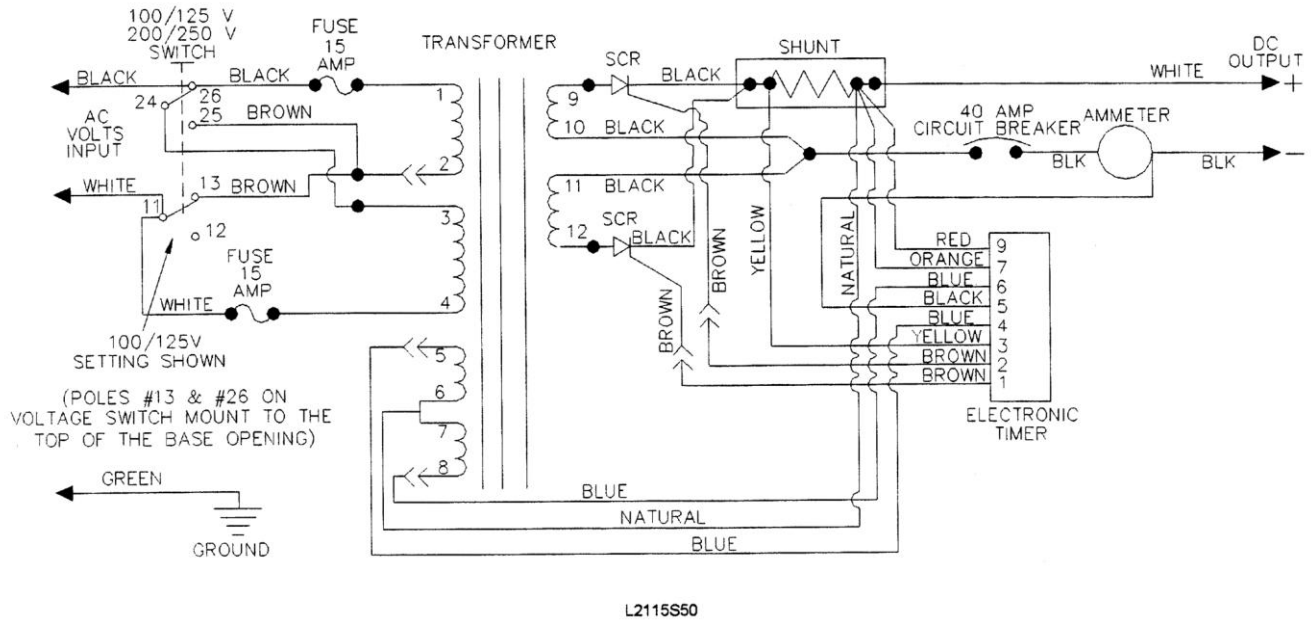
## BUILT-IN / PORTABLE 25A CHARGER




### Parts list for LESTRONIC II charger MODEL 09695
### TYPE 48LC25-8ET 115 VAC 60 Hz

| *PART NO* | *DESCRIPTION* |
|---|---|
| 09727S | CASE ASSEMBLY |
| 09696S | TRANSFORMER ASSEMBLY |
| 16354S | HEATSINK ASSEMBLY, WITH DIODES |
| 04127S | AMMETER |
| 09664S | ELECTRONIC TIMER ASSEMBLY (RELAY – 03735S) |
| 02390S | CAPACITOR, 6.0 MFD, 660 VAC |
| 08776S | FUSE ASSEMBLY |
| 02028S | BUSHING, 7W-2, INSULATOR FOR CORDSETS |
| 02506S | CORDSET, AC |
| 08512S | CORDSET, DC, NO PLUG |
| 14973S | CORDSET, DC, WITH SILICONE PLUG |
| 8020S | CORDSET, DC, WITH LESTER PLUG |
| 08607S | CORDSET, DC, WITH 50 AMP ANDERSON PLUG |
| 10536S | CORDSET, DC, WITH 50 AMP EZ GO PLUG |
| 08224S | CORDSET, DC, WITH 175 AMP ANDERSON PLUG |
| 08313S | PLUG ASSY, DC, 50 AMP ANDERSON PLUG |
| 02957S | PLUG ASSY, DC, 175 AMP ANDERSON PLUG |

## BUILT-IN/PORTABLE CHARGER MODEL 16510

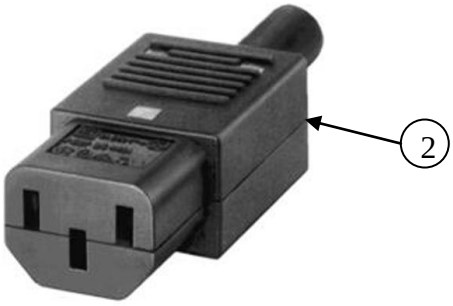



L2115S50

### Parts list for MODEL 16510
### TYPE 48EL20-8ET
### 100-125 or 200-250 VAC / 50-60 Hz

| *PART NO* | *QTY.* | *DESCRIPTION* |
|---|---|---|
| 21149S | 1 | CASE ASSEMBLY |
| 15945S | 1 | TRANSFORMER ASSEMBLY |
| 16369S | 1 | AMMETER |
| 16595S | 1 | ELECTRONIC TIMER ASSEMBLY |
| 18696S | 1 | SHUNT ASSEMBLY |
| 21249S | 2 | HEATSINK ASSEMBLY, W/ SCR |
| 21152S | 1 | CONTROL CABLE ASSEMBLY |
| 02028S | 1 | BUSHING, INSULATOR, 7W-2, FOR AC CORDSET |
| 02008S | 1 | BUSHING, INSULATOR, 8P-2, FOR DC CORDSET |
| 21147S | 1 | CORDSET, AC, 14/3,W/ PLUG |
| 25248S | 1 | CORDSET, AC, 1.5mm$^3$, HARMONIZED, NO PLUG |
| 28113S | 1 | CORDSET, DC, SY120 PLUG, GRAY |
| 29052S | 1 | CORDSET, DC, LESTER PLUG, GRAY |
| 21146S | 1 | CORDSET, DC, NO PLUG |
| 05322S | 1 | FUSEHOLDER |
| 16499S | 2 | FUSE, 15 AMP, MDA-15 |
| 17558S | 1 | SWITCH, ROCKER, DPDT |
| 21333S | 1 | CIRCUIT BREAKER, 40 AMP |

## DELTA-Q HF CHARGER




| *NO* | *PART NO* | *DESCRIPTION* |
|---|---|---|
| 1 | 3102240002 | 24V CHARGER ( U.S. BATTERY ) |
| | 3102240003 | 24V CHARGER ( LIFELINE BATTERY ) |
| | 3102302001 | 36V CHARGER ( U.S. BATTERY ) |
| | 3102302002 | 36V CHARGER ( LIFELINE BATTERY ) |
| | 3102480002 | 48V CHARGER ( U.S. BATTERY ) |
| | 3102480003 | 48V CHARGER ( LIFELINE BATTERY ) |
| 2 | 3119000011 | CONNECTOR C13 |

QuiQ™ HF/PFC Battery Charger

**Product Manual for:**
**QuiQ 912-24xx / 36xx / 48xx / 72xx**

delta-q TECHNOLOGIES
Unit 3 – 5250 Grimmer St.
Burnaby, BC, Canada V5H 2H2
Tel: 604.327.8244 Fax: 604.327.8246
www.delta-q.com

# SAVE THESE IMPORTANT SAFETY INSTRUCTIONS

This manual contains important safety, operating, and installation instructions – read before using charger.

**Battery Safety Information**

**Warning: Use charger only on battery systems with an algorithm selected that is appropriate to the specific battery type. Other usage may cause personal injury and damage. Lead acid batteries may generate explosive hydrogen gas during normal operation. Keep sparks, flames, and smoking materials away from batteries. Provide adequate ventilation during charging. Never charge a frozen battery. Study all battery manufacturers' specific precautions such as recommended rates of charge and removing or not removing cell caps while charging.**

**Electrical Safety Information**

**Danger: Risk of electric shock. Connect charger power cord to an outlet that has been properly installed and grounded in accordance with all local codes and ordinances. A grounded outlet is required to reduce risk of electric shock – do not use ground adapters or modify plug. Do not touch uninsulated portion of output connector or uninsulated battery terminal. Disconnect the AC supply before making or breaking the connections to the battery while charging. Do not open or disassemble charger. Do not operate charger if the AC supply cord is damaged or if the charger has received a sharp blow, been dropped, or otherwise damaged in any way – refer all repair work to qualified personnel. Not for use by children.**

# INFORMATIONS IMPORTANTES DE SÉCURITÉ

Conserver ces instructions. Ce manuel contient des instructions importantes concernant la sécurité et le fonctionnement.

**Information de Sécurité de la Batterie**

**Attention: Utiliser seulement sur les batteries 72V avec un algorithme approprié au type spécifique de batterie – voire le manuel. D´autres types de batteries pourraient éclater et causer des blessures ou dommages. Les batteries peuvent produire des gaz explosives en service normal. Ne jamais fumer près de la batterie et éviter toute étincelle ou flame nue à proximité de ces derniers. Fournisser la bonne ventilation lors du chargement. Ne jamais charger une batterie gelée. Prendre connaissance des mesures de précaution spécifiées par le fabricant de la batterie, p. ex., vérifier s´il faut enlever les bouchons des cellules lors du chargement de la batterie, et les taux de chargement recommandés.**

**Information de Sécurité Électrique**

**Danger: Risque de chocs électriques. Ne pas toucher les parties non isolées du connecteur de sortie ou les bornes non isolées de la batterie. Toujours connecter le chargeur à une prise de courant mise à la terre. Ne pas ouvrir ni desassembler le chargeur – referer toute reparations aux personnes qualifiés. Pas à l´usage des enfants.**

## Operating Instructions

1. Always use a grounded outlet. When using an extension cord, avoid excessive voltage drops by using a grounded 3-wire 12 AWG cord.
2. The charger will automatically turn on and go through a short LED indicator self-test (Models 912-xx0x will flash all LED's in an up-down sequence and Models 912-xx1x will alternatively flash its LED RED-GREEN) for two seconds. If the charger is connected to battery pack, a trickle current will be applied until a minimum voltage is reached. If the charger is used in an off-board application and the charger is waiting to be plugged into a battery pack, the charging algorithm number will be displayed for 11 seconds (see "Check / Change Charging Algorithm") before ultimately displaying an under-voltage fault (fault disappears when plugged into battery pack).
3. Once a minimum battery voltage is detected, the charger will enter the bulk charging constant-current stage. Models 912-xx0x will display the current to the battery on the bargraph and Model 912-xx1x will flash its LED GREEN off more than on to indicate <80% charge status. The length of charge time will vary by how large and how depleted the battery pack is, the input voltage (the higher, the better), and ambient temperatures (the lower, the better). If the input AC voltage is low (below 104VAC), then the charging power will be reduced to avoid high input currents (Models 912-xx0x 'AC' LED and Models 912-xx1x single LED both flash YELLOW). If the ambient temperature is too high, then the charging power will also be reduced to maintain a maximum internal temperature (Models 912-xx0x bargraph flashes and Models 912-xx1x single LED flashes YELLOW).
4. When the battery is at approximately 80% state of charge, the bulk stage has completed and an >80% charge indication is given (Models 912-xx0x turn on the '80%' LED and Models 912-xx1x will flash its LED GREEN on more than off). In the next phase known as the absorption or constant-voltage phase, the last 20% of charge is then returned to the battery. The charging could be terminated at this point if the vehicle requires immediate usage, however, it is highly recommended to wait until 100% charge indication is given to ensure maximum battery capacity and life.
5. A low current "finish-charge" phase is next applied to return and maintain maximum battery capacity (Models 912-xx0x will flash the '100%' LED).
6. When Models 912-xx0x '100%' LED or Models 912-xx1x single LED is continuously GREEN, the batteries are completely charged. The charger may now be unplugged from AC power (always pull on plug and not cord to reduce risk of damage to the cord). If left plugged in, the charger will automatically restart a complete charge cycle if the battery pack voltage drops below a minimum voltage or 30 days has elapsed.
7. If a fault occurred anytime during charging, a fault indication is given by flashing RED with a code corresponding to the error. There are several possible conditions that generate errors. Some errors are serious and require human intervention to first resolve the problem and then to reset the charger by interrupting AC power for at least 15 seconds. Others may be simply transient and will automatically recover when the fault condition is eliminated. To indicate which error occurred, a fault indication will flash RED a number of times, pause, and then repeat.
   [1 FLASH] Battery Voltage High: auto-recover
   [2 FLASH] Battery Voltage Low: auto-recover
   [3 FLASH] Charge Timeout: the charge did not complete in the allowed time. This may indicate a problem with the battery pack (voltage not attaining the required level), or that the charger output was reduced due to high ambient temperatures.
   [4 FLASH] Check Battery: the battery pack could not be trickle charged up to the minimum level required for the charge to be started. This may indicate that one or more cells in the battery pack are shorted or damaged.
   [5 FLASH] Over-Temperature: auto-recover. Charger has shutdown due to high internal temperature which typically indicates there is not sufficient airflow for cooling – see Installation Instructions 1). Charger will restart and charge to completion if temperature comes within accepted limits.
   [6 FLASH] QuiQ Fault: an internal fault has been detected. If Fault 6 is again displayed after interrupting AC power for at least 15 seconds, the charger must be brought to a qualified service depot.

## Maintenance Instructions

1. For flooded lead-acid batteries, regularly check water levels of each battery cell after charging and add distilled water as required to level specified by battery manufacturer. Follow the maintenance and safety instructions recommended by the battery manufacturer.
2. Make sure charger connections to battery terminals are tight and clean.
3. Do not expose charger to oil, dirt, mud or to direct heavy water spraying when cleaning vehicle.

See flip side for **Product Specifications** and **Installation Instructions** for qualified personnel.

## Specifications

**DC Output – see Operating Instructions**

| QuiQ Model: 912- | 24xx | 36xx | 48xx | 72xx |
|---|---|---|---|---|
| Voltage-nom (V) | 24 | 36 | 48 | 72 |
| Voltage-max (V) | 33.6 | 50.4 | 67.2 | 100 |
| Current-max (A) | 25 | 21 | 18 | 12 |
| Battery Type | Specific to selected algorithm | | | |
| Reverse Polarity | Electronic protection – auto-reset | | | |
| Short Circuit | Electronic current limit | | | |

**AC Input**

| All models | |
|---|---|
| Voltage-max (Vrms) | 85 – 265 |
| Frequency (Hz) | 45 - 65 |
| Current-max (Arms) | 12A @ 104VAC (reduced 20%<104V) |
| Current – nominal (Arms) | 10A @ 120VAC / 5A @ 230VAC |
| AC Power Factor | >0.98 at nominal input current |

**Operation**

| Charger Model: 912- | xx0x (10 LED) | xx1x (1 LED) |
|---|---|---|
| AC ON | Solid YELLOW | LED Active |
| AC LOW | Flash YELLOW | Flash YELLOW |
| Thermal Cutback | Flash Bargraph | Flash YELLOW |
| <80% Charge Indicator | - | Short Flash GREEN |
| >80% Charge Indicator | Solid YELLOW | Long Flash GREEN |
| 100% Charge Indicator | Solid GREEN | Solid GREEN |
| Fault Indicator | Flash RED | Flash RED |
| DC Ammeter | LED Bargraph | - |
| Bat Temp Compensation | Automatic | Optional |
| Maintenance Mode | Auto-restart if V<2.1Vpc or 30 days elapse | |

**Mechanical**

| All models | |
|---|---|
| Dimensions | 28.0 x 24.5 x 11.0 cm (11 x 9.7 x 4.3") |
| Weight | <5 kg (<11 lbs) w/ standard output cord |
| Environmental | Enclosure: IP46 |
| Operating Temperature | -30°C to +50°C (-22°F to 122°F), derated above 30°C, below 0°C |
| Storage Temperature | -40°C to +70°C (-40°F to 158°F) |
| AC input connector | IEC320/C14 (require ≥1.8m localized cord) |
| DC output connector | OEM specific w/ 12AWG wire |

**Regulatory**

| Safety | |
|---|---|
| EN 60335-1/2-29 | Safety of Appliances/ Battery Chargers |
| UL2202 | EV Charging System Equipment |
| UL1564 2nd Edition | Industrial Battery Charger |
| CSA-C22.2 No. 107.2 | Battery Chargers- Industrial |
| **Emissions** | |
| FCC Part 15/ICES 003 | Unintentional Radiators Class A |
| EN 55011 | Radio disturbance characteristics (Class A) |
| EN 61000-3-2 | Limits for harmonic current emissions |
| EN 61000-3-3 | Limits of voltage fluctuations and flicker |
| **Immunity** | |
| EN 61000-4-2 | Electrostatic discharge immunity |
| EN 61000-4-3 | Radiated, radio-frequency, EMF immunity |
| EN 61000-4-4 | Electrical fast transient/burst immunity |
| EN 61000-4-5 | Surge immunity |
| EN 61000-4-6 | Conducted Immunity |
| EN 61000-4-11 | Voltage variations immunity |

## Installation Instructions

**WARNING: The output of chargers with greater than 48V may pose an energy and/or shock hazard under normal use. These units must be installed in the host equipment in such a manner that the output cable and battery connections are only accessible with the use of a tool by qualified personnel.**

**1) Determine Mounting Location:**
While its sealed nature allows the charger to be mounted virtually anywhere, the choice of mounting location and orientation is extremely important. For optimum performance and shortest charge times, mount the charger in an area with adequate ventilation. The charger should also be mounted in an area that will be relatively free of oil, dirt, mud, or dust since accumulations within the fins of the charger will reduce their heat-dissipating qualities. Optimal cooling also occurs when the charger is mounted on a horizontal surface with the fins vertical. More airflow from below the charger will help cool the fins, so mounting above open areas or areas with cut-outs for airflow is desirable. Contact Delta-Q for information on other mounting orientations. As the charger may get hot in operation, the charger must be installed such that risk of contact by people is reduced. The charger's AC plug must be located at least 18" above the floor/ ground surface and the status display must be visible to the user.

**2) Mounting Procedure:**
Mount the charger by the mounting plate using appropriate fasteners (i.e. 1/4" or M6 with locking hardware). For UL2202 compliance, a 12AWG green bonding wire with ring terminals must be attached from the bonding stud located on the front of the charger (identified by ⏚) to the vehicle frame. The vehicle connection must be made using corrosion resistant hardware (e.g., a #10 stainless steel machine screw with at least two threads of engagement and, if required, a paint piercing washer).

**3) DC Battery Connection Procedure:**
a) The green wire outputs battery voltage when the charger is not plugged into AC to provide an interlock function – see Fig. 1. **If used, a user-supplied 1A fast-blow external fuse must be installed inline to prevent damage. Shorting or drawing more than 1A may damage charger and void the warranty.**
b) Securely fasten the black ring terminal from the charger to the negative terminal ("-", "NEG", NEGATIVE") of the battery pack.
c) Check that the correct charge algorithm is being used – refer to section 4). Securely fasten the red ring terminal to the positive terminal ("+", "POS", "POSITIVE") of the battery pack.

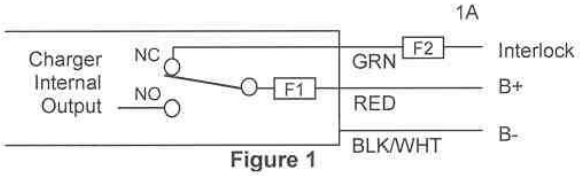



Figure 1

**4) Check / Change Charging Algorithm:**
The charger comes pre-loaded with algorithms for batteries as detailed in Table 1. If your specific battery model is not listed, please contact Delta-Q.
Each time AC power is applied with the battery pack NOT connected, the charger enters an algorithm select/display mode for approximately 11 seconds. During this time, the current Algorithm # is indicated on the '80%' LED (Models 912-xx0x) or on the single LED (Models 912-xx1x). A single digit Algorithm # is indicated by the number of blinks separated by a pause. A two digit Algorithm # is indicated by the number of blinks for the first digit followed by a short pause, then the number of blinks for the second digit followed by a longer pause.
To check / change the charging algorithm:
a) Disconnect the charger positive connector from battery pack. Apply AC power and after the LED test, the Algorithm # will display for 11 seconds.
b) To change algorithm, touch positive connector during the 11 second display period to the battery pack's positive terminal for 3 seconds and then remove – the Algorithm # will advance after 3 seconds. Repeat until desired Algorithm # is displayed. A 30 second timeout is extended for every increment. Incrementing beyond the last Algorithm moves back to the first Algorithm. After desired Algorithm # is displayed, touch the charger connector to the battery positive until the output relay is heard to click (~10 seconds) – algorithm is now in permanent memory.
c) Remove AC power from the charger and reconnect the charger positive connector to the battery pack. It is highly recommended to check a newly changed algorithm by repeating step 4) above.

| Alg # | Battery Type |
|---|---|
| 35 | Concorde 2xxAh AGM |
| 27 | Crown CR325 dv/dt |
| 26 | Deka 8GGC2 Gel |
| 11 | generic flooded CP dv/dt |
| 8 | Concorde 1xxAh AGM |
| 7 | Trojan J305 dV/dt |
| 6 | DEKA 8G31 Gel |
| 5 | Trojan 30XHS |
| 4 | US Battery US2200 |
| 1 | Trojan T-105 |

**Table 1.**

**Product warranty is two years - please contact dealer of original equipment for warranty service.**

**Note: This is a Class A product. In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.**

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# MOTREC ILLUSTRATED ACCESSORIES

Strobelight, polemount
Amber 12-80V: 3116000001
Red 12-80V: 2469001
Blue 12-80V: 3690008

Strobelight, cab mount
Amber 12-48V: 3116250001
Red 12-48V: 3069026
Blue 12-48V: 3069014
Amber 72-80V:3116720001
Red 72-80V: 3116720002
Blue 72-80V: 3116720003

Amber turn lamp
12V: 3069020
Bulb 12V: 3069021
Multi-LED amber turn lamp
Round Light: 3111000010
Grommet: 3111000008
Plug: 3111000009

Red Tail/Brake light
Grommet: 3269001
Plug: 246012A
12V : 2469021
24V : 2469022

Red Tail/Brake light
Housing: 3069012R
Bulb 12V: 3117240001

Back-up lamp
Grommet: 3269001
12V: 3669012
24V: 3669012A

Clear lamp
12V: 3069012
Bulb 12V: 1269008

Pedestral head lamp
12V: 2569001
Bulb 12V: 2569001B
Bulb 24V: 4469001

Headlight
Left: 3111480003
Right: 3111480004
Bulb H/L: 3111480006
Bulb Turn: 3111480008
Bulb Mark: 3111480007

Headlight
Left: 3111480003
Right: 3111480004
Bulb H/L: 3117480001
Bulb Turn: 3117480003
Bulb Mark: 3117480002

Turn signal switch
246050

Multi-LED Red Tail/Brake
Light: 3111000006
Grommet: 3111000008
Plug: 3119000009

Multi-LED Back-up
Light: 3111000007
Strobe light: 3111000013
Grommet: 3111000008
Plug: 3119000009

Horn
12V: 246003
24V: 246013

Horn button VIP
2330014

Horn button, column mount
246210

Horn button, dash mount
266210

Horn button 3109250001

Limit switch
3030015

Back-up alarm
12-48V : 3100000001
72-80V : 3105720001

Red Tail/Brake light
12V: 386002

Analog Voltmeter

| | |
|---|---|
| 12V : | 3069007 |
| 24V : | 2469002 |
| 36-48V : | 3669002 |

HOBBS Gauge

| | |
|---|---|
| 24V: | 2469026 |
| 36V: | 3069038 |
| 48V: | 4869037 |

DC-DC converter, 10A

| | |
|---|---|
| 12-48V: | 3069019 |

DC-DC Converter, 25A

| | |
|---|---|
| 12-48V: | 3124000002 |
| 72-80V: | 3124880001 |

Wiper motor

| | |
|---|---|
| 12V: | 3113000001 |
| 24V: | 486211 |

Wiper arm 2800000001

Wiper blade

| | |
|---|---|
| 14” Blade: | 2800000002 |
| 18” Blade: | 2800000003 |

Pantograph wiper arm 246233A

Pantograph wiper blade 246233

Cab heater

| | |
|---|---|
| 12V: | 3103300001 |
| 36V: | 3669008 |
| 48V: | 4869020 |

12V Dome light 3669006

12V Fan 3669013

Headlamp 12V:3111250002

Headlamp

| | |
|---|---|
| 12V: | 3111300001 |
| Bulb 12V: | 3111300002 |

Red Pilot light

| | |
|---|---|
| 12V: | 246212 |
| Bulb 12V: | 246212B |

# BATTERY DISCHARGE INDICATOR (HOBBS)

This indicator monitors :
- the residual capacity of batteries;
- operating hours;
- status of service down counter.

The residual capacity of the battery is monitored via an 8-LED bar display. When the left red LED lights, the batteries must be charged to avoid damage. The LED display starts flashing as a pre-warning signal. The lower voltage limit is adjustable via potentiometer “M” on the rear.

| A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,57 | 1,63 | 1,68 | 1,73 | 1,78 | 1,82 | 1,84 | 1,86 | 1,89 | 1,91 | 1,93 |

In order to activate a new adjustment, the unit has to be reset :
- 2.35V/cell reset voltage with battery remaining in vehicle;
- 2,09V/cell reset voltage after battery has been disconnected.

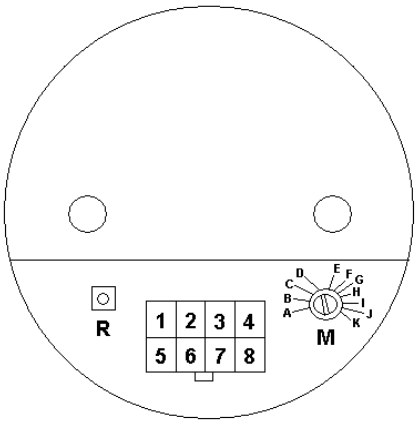
To maintain a good battery performance, it is recommended to limit the discharging to 80% of the battery capacity. The recommended setting for 6V batteries is F and the recommended setting for an industrial battery is K.

An internal relay can prevent overdischarging and damaging the batteries. The relay can be wired to cut off the reverse direction, or energize an N.C. relay and alarm.
Turning off and on the vehicle will override the protection for 30 sec.

The current status (remaining operating hours before maintenance) of the service down counter is indicated for a period of 5 seconds after the key switch is turned on. When it is down to 0, the display flashes. After the maintenance, reset the counter: depress the button “R” on the rear. The service counter is factory programmable only.

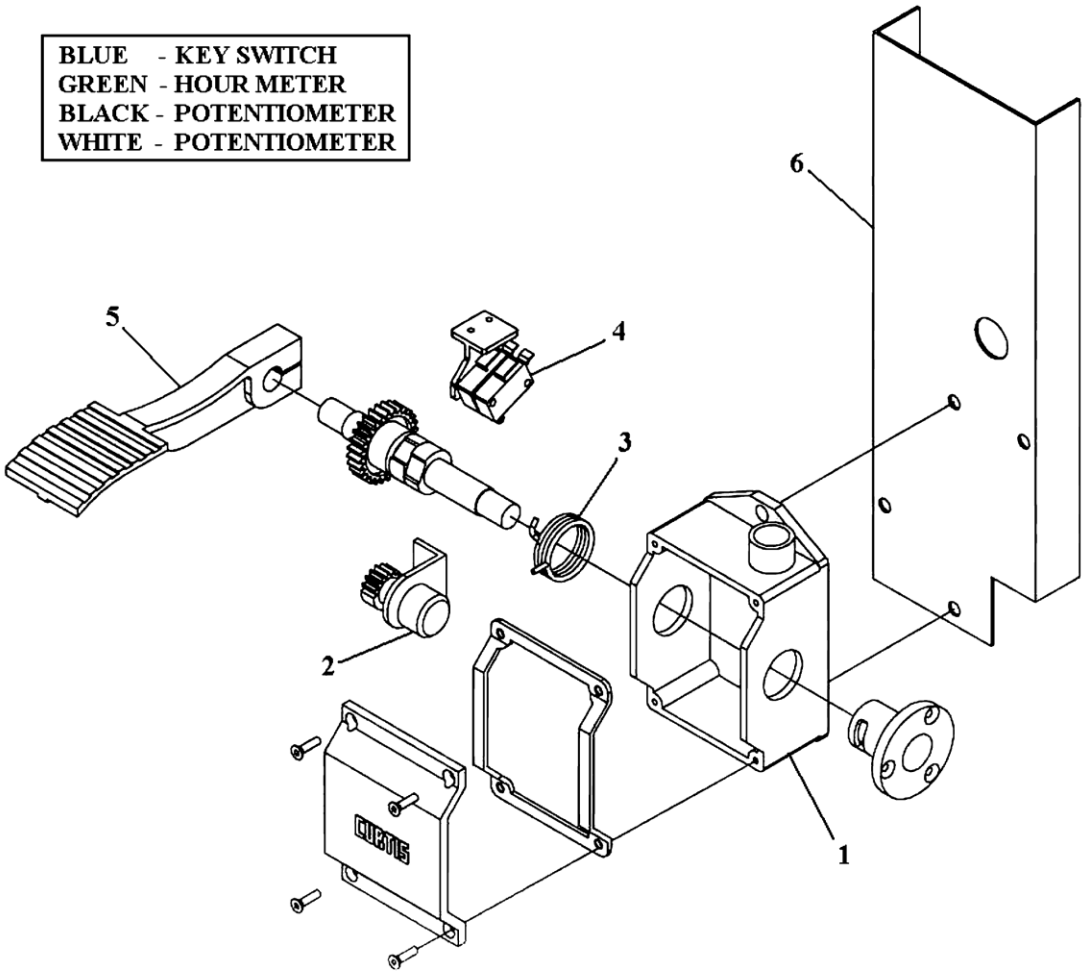
24V UNIT #: 2469026
36V UNIT #: 3069038
48V UNIT #: 4869037

2- Orange, key switch
3- Relay +
4- Relay -
5- Black, battery –
6- Blue, hour counter
8- White, battery +



# ADDENDUM

## CURTIS FOOT PEDAL




| *REF.* | *PART. NO* | *DESCRIPTION* |
|---|---|---|
| ***1*** | ***3062001C*** | ***ACCELERATOR CURTIS*** |
| ***2*** | ***367008*** | ***POTENTIOMETER*** |
| ***3*** | ***2262004C*** | ***SPRING*** |
| ***4*** | ***2262001C*** | ***MICRO-SWITCH*** |
| ***5*** | ***2262003C*** | ***LEVER*** |
| ***6*** | ***3662002*** | ***CABLE PROTECTOR*** |

| | |
|---|---|
| *RESP :* ***CLAUDE L*** | MODEL(E) : **E-320/360/480/500** |
| *NO :* ***321A320001*** | *SER :* ***1018799*** *TO/À :* ***1019973*** |